TROPICAL AGRICULTURE

THE OFFICIAL JOURNAL OF THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE

VOL. V No. 4. APRIL, 1928. PRICE 6d.

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THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD, B.W.I.

Cables :: "Stomata." | Phone :: 1983.

TROPICAL AGRICULTURE is published at the Imperial College of Tropical Agriculture, St. Augustine, Trinidad, West Indies, at the end of the third week of the month preceding the one of issue. Advertisement rates can be obtained at the College from the Editor, or from the Secretary of the College, 14, Trinity Square, London, E.C. 3, England. The Editor will be glad to consider authoritative articles for publication. It is understood that opinions expressed in signed articles are those of the author and do not necessarily represent the policy or opinion of the College Authorities. Increasing numbers of inquiries are being received from various parts of the tropics which can be answered only by persons possessed of an intimate knowledge of local conditions. Enquirers should first satisfy themselves that their local Department of Agriculture is not able to supply them with the desired information before communicating with us. Correspondence which will be replied to is invited on all other matters pertaining to tropical agriculture, science and development.

EMPIRE MARKETING.

IT is indeed fortunate that the Government of the Empire has at last taken active steps through the constitution of an Imperial Economic Committee to deal with the problem of agricultural economics, but more particularly with that branch of it which concerns itself with marketing. Appointed to carry out the Committee's recommendations and as its official organ, the Empire Marketing Board should do much in the future towards devising means of improving existing methods of marketing Empire produce in the United Kingdom and also, it is hoped, in studying local conditions of production and supply together with external demand. In addition to the Board's activities the Ministry of Agriculture's Marketing and Co-operation Branch is specialising with the problem of Co-operative Marketing. In Canada, the Farm Economics Department of the Ontario Agricultural College has investigated the marketing of butter, cheese and tobacco. In South Africa the Division of Agricultural Economics, Markets and Co-operation has studied the organisation of public markets and, in addition, commenced inquiries into the marketing of certain commodities. It will be seen that the Empire, like other countries, is becoming fully alive to the need of research in the subject.

There is no doubt that the problem of marketing offers exceptional difficulties. The investigator is primarily faced with three varying factors of which, more often than not, statistical information is incomplete or totally inadequate. These three factors are population, supply and demand. Again, methods of marketing are themselves apt to undergo constant modifications while the subject itself can only be studied on a commodity basis which is naturally going to prolong research. Taking these main points into consideration it is not surprising to find that ideal conditions of marketing, which would imply efficient collection and distribution of produce with adequate remunerations to the producer and distributive agencies, together with a fair price to the consumer, are seldom found. But it is still more surprising to discover how efficiently the present machinery is running, even with its shortcomings, when one pauses to consider the obstacles that are in the way.

What the Empire Marketing Board will be mainly concerned with in the future will be the study of the two aspects of marketing produce. The first involves the mechanism of marketing, and the second marketing conditions or the

relationship between supply and demand. Mechanism of marketing deals entirely with the means by which produce is moved from the producing area to the consumer. Although a small amount of produce is sold direct to the consumer the greater part passes through a large number of hands before it reaches the final market. Most products are, in addition, disposed through irregular and regular channels. The assembling, storage and disposal of produce, all of which have to be financed and insured, are the chief functions of the marketing machine. Additional services consist of processing, grading, packing and standardisation. It is for the Empire Marketing Board to judge the usefulness of the work performed by and the efficiency of the local market, the commission salesman, the whosesale merchant, the commission buyer, the retailer and the transport agency in carrying out the functions already enumerated. To condemn the work of certain distributive agencies, which some irresponsible critics are apt to do, as that of parasites, merely shows the ignorance on the subject of the mechanism of marketing.

The second problem which will have to be faced by the Empire Marketing Board is that of marketing conditions. With regard to supplies it will be their business to obtain information about the quantities and quality of home or imported produce that is likely to be moved into a particular market, and also about the actual production, seasonality and localisation of the commodity. In addition they will have to study the causes of the irregularity of supplies and find means of overcoming the temporary gluts or deficiencies which are apt to throw the marketing machinery out of gear. Irregularities in supply may be due to insufficient knowledge of the markets by the producer, insufficient storage accommodation, need of ready money, natural conditions giving rise to sudden or seasonal increase in production and so on. Finally the Empire will look to them to suggest some definite organisations which might be adopted to collect and level supplies and to dispose of surplus produce on inferior markets so as to obtain, by careful adjustments, the best average price for the whole season's produce. The marking of supplies is now receiving the Board's attention and certain standard methods of packing have already been suggested.

With regard to demand the Board will be somewhat handicapped by the lack of statistics on the subject, but their duties in the first place will be to study the consumer's needs and at the same time to teach the producers to cater for the markets by asking them to supply the specific grades of produce that may be required with an eye to quantity and quality. It will also be their function to mobilise the consumer into buying Empire produce as against Foreign, and this is already being done by an extensive campaign of publicity and education. This campaign's main object is to show to the public that by buying specially marked Empire produce of which certain lines excel in quality, the increased demand created overseas for the manufactured products of the United Kingdom will eventually stimulate employment at Home. They intend to make such publicity continuous so that there will be constant efforts in the way of foreign competition. Once a knowledge of demand over wide areas has been obtained, it will be easier for the Board to see that supplies are directed into their proper channels and to examine the development in marketing organisation and of new methods of marketing technique.

The present analysis of the Board's two principal functions, that is, the study of the marketing machine and of marketing conditions has been given in some detail so as to point out the numerous intricacies of the subjects. The Board will have many additional objects in view such as the fostering of the idea of inter-Imperial Trade and overseas settlement, the revision of legislation with regard to the marking of Empire produce and many other schemes for the general improvement of Empire trade. It should be of particular interest to readers of this Journal, however, to know that part of the annual grant for research work will be devoted to the development of trade in fruit produced in the tropical portions of the Empire. With the help of this grant a most comprehensive fruit report has already been published of which two sections have been devoted entirely to the production and marketing of citrus and bananas.

One of the main problems with regard to the producer in the tropics and particularly with the small man is that however proficient he may be as an agriculturist he often does not reap the benefit of producing goods of first class quality. Many of the small growers and peasants sell for what they can get in the local markets to agents of trading organisations which in turn dispose of the produce after it has been graded and packed by them. The good produce, however, finds its way initially amongst the bad and it is the trader that benefits, and not the producer, by standardising what he has bought. Clearly there are here plenty of opportunities for devising methods of overcoming the disadvantages of such a system of sale; producers' organisations might be formed which while leaving the producer to do his share of the work, would give him, as a member, due credit for his grade of product. It was recommended in the Imperial Economic Committee report on the banana trade that financial assistance should be given to encourage the formation of growers' associations. Such organisations would be in a much stronger position to express their views about their own trade and to establish a shipping service to deal with their members' products. Again, they might employ trained men to study the question of supply and demand with regard to their produce, and these should preferably be trained agriculturists with a general knowledge of business. By travelling in both the producing and consuming areas

they could collect invaluable information which would eventually be passed on to the growers and as such form the direct link which is so necessary between producers and consumers. From an educational point of view they would also be of invaluable assistance to the growers. The strongest incentive to co-operation is its vital necessity and the small man in the tropics by being placed so far away from his ultimate market is in great need of some kind of organisation and it is for him to set about the problem as soon as possible. The Government has already expressed its willingness to help, but it is for the producer to take the initiative.

There is no single remedy that can be applied to the inefficiencies or inadequacies of the existing systems of marketing. All that can be done is to organise, applying this term in its widest sense. Growers of tropical produce should confine their attention to this word "organisation," adopting, if possible, co-operative methods which would improve their standard of produce and its presentation and thereby ensure higher prices, eliminate waste in transport, handling and merchandising and regulate the quantity and quality of the produce put on the market. The Empire Marketing Board, while they are doing extremely good work on the side of the consuming area should realise that the producers' side is just as important. They might, with advantage, make detailed marketing surveys of all the staple agricultural products in the tropics such as sugar, cacao, coffee, tea and others paying special attention to the problems of the small agriculturists, who want to be made to feel that the consumer is able, as a result of improved methods, to discriminate between his produce and that coming from foreign sources. Meanwhile an extensive advertising campaign has been started in the United Kingdom to popularise the use of Empire produce and it is the duty of Empire growers to do their utmost to supply the demand that will arise in future as a result of this campaign.

The following appointments have been made by the Secretary of State for the Colonies during the month ended 31st January, 1928.

Mr. F. J. Nutman, B.Sc., A.R.C.S., Plant Physiologist, Amani Institute, Tanganyika Territory.

Mr. W. O. Sunman, B.Sc., Assistant Agricultural Officer, Kenya Colony.

Mr. J. W. Wallace, B.Sc., Superintendent, Agricultural Department, Nigeria.

We acknowledge with thanks the receipt of a leaflet which gives details of the results obtained by the use of a mixture of Potash Manures on the Tobacco crop. This can be obtained from the Agricultural Adviser, the Dominions Supply Co., Ltd., 41, Eastcheap, London, E.C.3.

DACCA RESEARCH STATION.

By R. S. Finlow, F.I.C.
Director of Agriculture, Bengal.

The Agricultural Research Station at Dacca is the headquarters of the Bengal Department of Agriculture. It is situated on the Mymensingh Road three miles north of Dacca. The site was chosen in the latter part of 1905, but the laying out of the farm and erection of the buildings was not completed till 4 years later.

The station which has an area of 350 acres is situated on the red soil area, known as the "old alluvium" which, apparently, originating in West Bengal, passes through portions of Malda, Rajahahi and Dinajpur (*Bahrind* tract) and then bifurcates, one portion passing through Rangpur into the Assam Valley and the other dipping under the Brahmaputra and re-appearing at Jamalpur (Mymensingh). The latter, persisting South and East, forms the "Madhupur Jungle" area of red soil in East Bengal, and occupies parts of the districts of Mymensingh, Dacca and Tippera.

The red soil area may be described as poor from an agricultural point of view, and much attention has therefore been given to studying its requirements. It is very deficient in lime and phosphate, also in available potash for fibre crops like jute for which Potash manures and lime appear to be essential. Phosphates are required for mustard and rice, and so, apart from Nitrogen, manures containing all these substances are occasionally necessary. Owing to the heavy rainfall, green manures do not produce their best effect in the monsoon, when the subsoil water table is near the surface. They should be ploughed in either before the rains begin, or just after the end of the monsoon, when the moisture content of the soil is more moderate.

The Madhupur Jungle tract, like the *Bahrind*, is in course of erosion and the area is split up into high lands and low lands. The latter, known as *bydes*, are the ravines or drainage channels and slope gradually towards rivers or to *bhils*.[1] They grow transplanted paddy in the upper levels, and broadcast deep water paddy lower down.

Suitably manured, as indicated, the high land grows most monsoon crops. Broadcast highland paddy does well; also jute and sugar-cane. There is, however, often difficulty in planting sugar-cane on account of lack of moisture, and the same cause frequently hinders the proper maturing of the crop after the monsoon is over. Generally *rabi*[2] crops do not pay, on account of lack of moisture in the cold season. Irrigation has been found to obviate all these difficulties and, in the absence of other adequate water supplies, the possibilities of tube well irrigation are being investigated. A 7-inch tube is being sunk on the Dacca Farm with this object in view.

1. Depressions in the alluvium, which hold water on the Monsoon and may be permanent lakes.
2. Cold season.

Transplanted paddy does well in the *bydas*; but its yield is markedly increased by phosphates, in addition to general manuring and, in the upper levels, irrigation is a paying proposition.

The application of lime and potash to a jute crop causes an increment of yield amounting to about 4 maunds of fibre per acre. Likewise, mustard will not grow without previous application of lime and phosphates. The same applies to maize and *Juar* (*Sorghum Vulgare*); but cowpea (*Vigna catiang*) and *bajra* (*Pennisetun typhoideum*), *Arhar* (*Cajanus indicus*) and chillies appear to require no special manuring.

In the last few years important results have been obtained in the manufacture of artificial cowdung, by fermenting vegetable refuse such as weeds, cane trash, &c., with bone and cattle urine, or byre washings. A large increase in the available supplies of manure has been the result and it has been found that Ammon Sulphate can substitute cattle urine; also that Ammophos and Diammophos, two proprietary preparations of ammonium phosphate, supply all necessary nitrogen and phosphate. The same of course applies to the Rothamstead preparation "Adco" which is however more expensive. The preparation of artificial farmyard manure is now a portion of the routine of all Government Farms and Sericultural nurseries.

Crop varieties.

Dacca has been the centre at which practically all crop research in Bengal has been done hitherto.

Rice.—The Economic Botanist has been working on this crop since his appointment in 1909. There are 22 million acres of rice in Bengal alone, including some thousands of varieties, and, during a debate at one of the earlier Indian Boards of Agriculture, justifiable doubt was expressed as to the possibility of obtaining any results of practical value within a reasonable time. Yet Dr. Hector and his assistants have achieved very valuable results indeed, and four or five pure line strains of different types of rice have been obtained, which are being grown on a wide and rapidly increasing scale throughout the province. These new varieties yield from 3 to 5 maunds per acre more grain than corresponding local types, and their dissemination is being pushed through the agency of small local seed farms, of 2 or 3 acres each, established wherever favourable conditions exist. Such conditions include not only the right type of land; a local person of sufficient energy and prestige to influence his neighbours is also necessary; but, in several instances, co-operative banks have rendered invaluable assistance, not only in organisation of the seed farm, but in arranging for storing of the paddy between harvest and the next sowing time. The establishment and maintenance of paddy seed farms, of which there are about 250, distributed all over the province, in the present season, now forms a definite and fruitful point of collaboration between the Departments of Agriculture and Co-operation.

Jute.—Work on jute, carried out by the Fibre Expert at Dacca, was done more or less on the same lines as that of paddy, and has resulted in 4 or 5 types which are now to be met with on a large scale throughout the jute growing tracts of Bengal, Bihar and Assam. These types, which yield about 4 maunds of fibre per acre more than local races, have more or less completely replaced the latter over large areas, and have already materially increased the capacity of North-Eastern India for the production of jute fibre. Conversely of course a given quantity of jute can be produced on about 25 per cent. less land than before so that the balance of land is available for the production of more food.

The extent of the demand for these improved jute races may be gauged from the fact that Rs. 1 lac (say £7,000) worth of seed was sold to cultivators for the current season's crop. That the public appreciates the value of these races is also indicated by the fact that, in the last year, the London Jute Association subscribed Rs. 20,000 only for assisting their dissemination. The offer was gratefully accepted by Government and action was taken which will substitute about 1,000,000 acres of local jute races by the Departmental improved races under discussion.

Moreover, the Indian Jute Mills Association guaranteed Government against loss on the sale of Departmental seed to the extent of Rs. 2½ lacs (£17,000) and a further guarantee for Rs. 65,000 (£4,500) has been extended to the season 1928.

Sugar-cane.—As a result of trials at Dacca, the variety Yellow Tanna is now being extensively grown throughout Bengal. Latterly hybrid canes, produced in the Government of India Sugar-cane Breeding Station at Coimbatore, notably Co. No. 213, have given exceedingly promising results. They are superior to Tanna, excepting in hardness, which implies resistance to jakal and pig—an important matter in Bengal—and are already in process of replacing Tanna in the sugar-cane growing tracts. The possibilities of these canes in Bengal are great and, given irrigation, it is believed that Bengal could produce at least enough sugar to be self-supporting in this respect.

All important staple crops in Bengal are being subjected to selection at Dacca with a view to producing improved strains. Apart from jute, rice, sugar-cane and tobacco, this refers also to oilseeds, pulses and wheat.

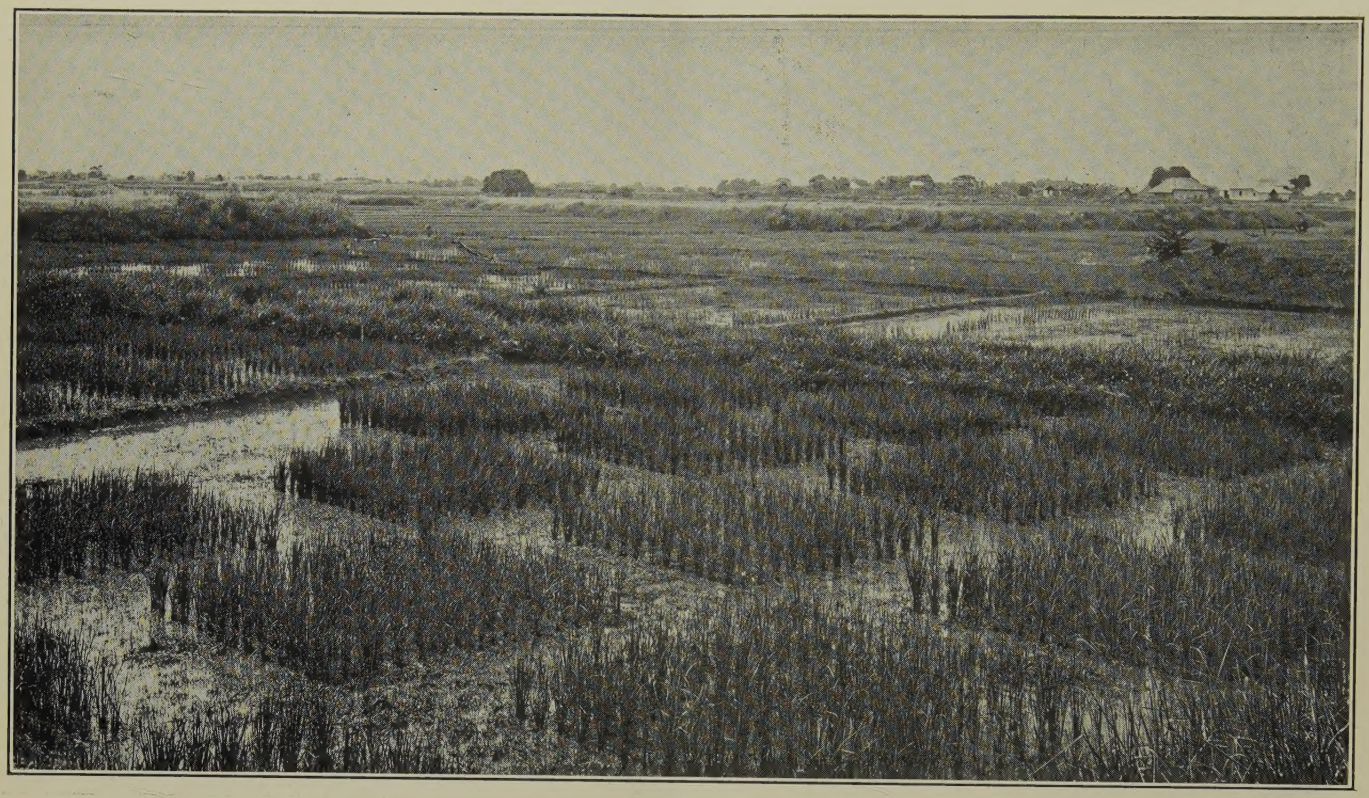
New crops, like ground-nuts and soy bean, are also under investigation, and are giving promising results in West Bengal.

For the improvement of cattle, there is a herd of Red Scindhis at Dacca, also a smaller herd of Tharpakars. The main cattle breeding centre at present is of course at Rangpur; but it is hoped to make Krishnagar, where the Company Bagan, extending over 450 acres, has been taken over, an important centre for investigation into cattle improvement.

DACCA RESEARCH STATION.

Agricultural Research Laboratories, Dacca Farm.

Making Artificial Farmyard Manure, Dacca Farm.



Pure Line Paddy (rice) selection plots, Dacca Farm.

Pure Line selection of Jute, Dacca Farm.

The method employed is to distribute good bulls, in which stature and milking capacity are prepotent. Red Scindhi bulls from Dacca, also half-bred Hansi bulls, and half-bred Tharpakar bulls, from Rangpur, are all popular, and the public demand for them has now outstripped the immediate supply. Since the recent appointment of Mr. Gossip, as Cattle Expert, a comprehensive scheme has been placed before Government and has received its approval.

Bound up with cattle improvement in Bengal is the question of fodder, and much work has been done at Dacca on this subject. Fodder crops from places as far apart as America, China and South Africa, in addition to indigenous crops, are under trial and, some have shewn such promise that they are already in demand from the public. There is much unwise talk from uninformed people about grazing grounds for cattle; but if it is a matter of fodder, well cultivated land will produce five times as much fodder as the same area of grass. This is certainly a point of crucial importance in a country where the population over which large tracts averages at least one thousand to the square mile.

At Dacca, during the monsoon, silage is made in a *pucca* tower; because the subsoil water level approaches the surface in that season. If, however, fodder crops are ready for cutting at the beginning of, or during the cold weather, they can be stored in pits, which are much cheaper than any masonry arrangement, to provide succulent food during the portion of the dry weather, when it is most needed.

Tobacco has received considerable attention at the hands of the Agricultural Chemist (Major Carbery). Selections of local tobaccos are not only spreading in recognized tobacco growing tracts but are also causing an appreciable increase in the area of tobacco. Exotic tobaccos, both for cigarettes and for cheroots, are grown and cured and the possibilities of the firing process for pipe tobacco are being investigated. Cheroots made from Manilla, Sumatra and Havana wrappers, and American fillers, all locally produced, are made, at present, on an experimental scale. An expert roller from Madras is employed and sales cover his wages. It is hoped to hand this proposition over to the Industries Department at an early date.

Implements have not yet received the attention they deserve, largely because the staff has not hitherto included an Agricultural Engineer. The latter is now about to be appointed, but in the meantime, power implements have been purchased and worked at Dacca, with advantage. A silage cutter and blower, apart from its regular work of cutting up green fodder for silage, performs the same function for the daily supply of cattle food more economically than it could be done by hand labour. A machine thresher threshes paddy at the rate of 40 maunds of grains an hour, and is particularly useful in the rains for aus paddy, which used to lie sometimes for weeks, awaiting fine enough weather to admit of threshing by treading out with bullocks in the ordinary way. The results was, not only extensive pilfering, but also deterioration of the grain, both for sowing and for eating purposes. Moreover, the straw became mouldy, and was of little use except for the manure heap. On these grounds alone the thresher will soon pay for itself. It has attracted the attention of cultivators, who have come to the Dacca Farm from 20 miles or more away, to see it work, and there is already talk of co-operative banks purchasing similar machines for use in the country side.

A Glasgow tractor has not been a success; but a Petter pumping set, and an Oshkosh pump, have enabled critical and invaluable results with irrigation to be obtained on sugar-cane, tobacco and cold weather fodder crops. Amongst cultivation implements, the spring tooth harrow, the Punjab and other iron ploughs, various Planet Junior implements, zig-zag harrows and a Cambridge roller are all usefully employed.

The research laboratories at Dacca are situated on the Farm, and consist of Chemical, Botanical and Fibre Sections. Each section is in charge of the officer of an Imperial Agricultural Service and, besides these, the Deputy Director of Agriculture in the Eastern Circle who is in charge of the Farm, and the Cattle Expert, both reside on the Farm. There is also a 2nd Economic Botanist.

The programme of the Chemical Section is as follows:—

(1) Soil Survey.
(2) Manurial Experiments.
(3) Sugar-cane and date-palm cultivation and extraction of sugar (already dealt with above).
(4) Cultivation, manuring and curing of tobacco (already described above).
(5) Soil Bacteriology.

A detailed Soil Survey is out of the question at present, on account of lack of staff; but sufficient work has been done to give a bird's-eye-view of the soil conditions of the province. The red soil area has already been described. The other great soil division of the Province is the *pali* or silt, tract. The soils of this area, which are deposited by the Brahmaputra and its tributaries, are much more fertile than the red soils. As a rule the former contain no free lime (Calcium carbonate), though there are exceptions, as at Rajahahi; but they are usually well supplied with phosphates, and, in places, the total potash content is as high as 2 per cent. which is comparable with the "flue dust" which was used in England, during the great war, as a potash manure. The most deficient plant food is Nitrogen, which can easily be understood in sedimented soils. In the *bhil* tracts, water-hyacinth (*Eichornia crassipes*) is used on an astonishing scale as a manure, and, at places as far apart as the northern borders of Rajahahi, and Dacca, cultivators cart water-hyacinth over considerable distances from *bhils* on to transplanted paddy land, or high land,

for purposes of fertilization. The manufacture of artificial farmyard manure is also of great importance in this connection.

Water cultures of different plants, carried out in conjunction with soil analyses, have given very valuable information regarding the food requirements of crops, and also with reference to the effect of different schemes of manuring on the availability of important plant food constituents. For instance, in the case of red soils, it was found that more than a certain dose of lime tends to immobilize available potash; moreover sugar-cane, grown on land so treated, gave much purer juice (*i.e.*, containing a markedly less percentage of glucose) than land not so treated. This is in entire agreement with previous observations that potash manuring tends to inhibit normal crystallization in the manufacture of cane sugar.

There are two Economic Botanists. The First Economic Botanist (Dr. Hector) devotes most of his attention to the overwhelmingly important paddy crop; but he also deals with pulses and fruit.

The Second Economic Botanist (Babu D. Dutta) is engaged with cotton; also with pulses, oilseeds and fodder crops. The cotton investigation has reference chiefly to West Bengal and to the *Bahrind* tracts of North Bengal, which have no revenue crop like jute. As far as space permits, the rest of the work of the critically important Botanical section has already been dealt with.

The work of the fibre section and the results obtained have already been described; but besides jute, it should be noted that other fibres receiving attention are Sunn Hemp, Sida, Flax, Agave and Rhea.

Agricultural Education.—There is at present no Agricultural College in Bengal, though a scheme for one received administrative approval as far back as 1920. Lack of funds has prevented materialization of the scheme, the essence of which is that students should receive all necessary pure scientific training before they enter the Agricultural Institute, and that the course at the latter shall be preponderatingly practical in character. The syllabus includes ordinary farming, simple surveying and building construction, a practical study of principal types of engines and machinery, practical demonstrations of plant breeding, cattle management, dairying, and estate law. We have experience to shew that men so trained, on the basis of a general knowledge of elementary pure science, imbibe their subsequent practical experience in such a way that they are capable of applying it later to useful effect. The obvious object of the scheme is to turn out an intelligent practical man as opposed to the purely theoretically trained person, who is so common a product of the ordinary system.

It will be realized, not only that the Agricultural Department in Bengal has widespread activities, but that it has already produced practical results of outstanding value to the agriculturist and to the presidency at large. The permanent settlement in Bengal prevents Government from taking direct advantage of the increased income which the cultivator is certainly earning as a direct result of the work of the Bengal Department of Agriculture. This increment of income is conservatively estimated at something like Rs. 2½ crores say (£1,700,000) per annum, while the cost of the Agricultural Department in Bengal approximates to Rs. 10 lacs (say £70,000) so, in spite of inevitable unreasoned and prejudiced criticism, there is no doubt of its being a sound investment for the province of Bengal. In fact the Bengal Agricultural Department, like other Departments of Agriculture in India, is another instance, if such were required, that sound and honest scientific work is bound to amply repay the expenditure involved in it.

EMPIRE TIMBERS.

The Advisory Committee on Timbers of the Imperial Institute, on which the Empire Forestry Association is represented by a member of the Governing Council and the Secretary of the Association, has in preparation a descriptive list of Empire timbers recommended as meriting wider utilisation. The timbers included in the list will comprise, in the main, "new" or comparatively little-known Empire woods examined by the Committee in the course of their enquiries and considered by them as suitable for general construction work, building and internal decorative purposes, furniture making and cabinet work, railway carriage and motor-body building. Many of the timbers described are recommended as the outcome of practical tests and trials carried out at the Imperial Institute or in the works of members of the Committee.

The countries of origin concerned are Canada, Australia, India, West Africa, British Guiana, British Honduras. Some thirty timbers are to be dealt with on the list. The trade and botanical names of each will be given, followed by an account of the characters and working qualities of the wood and suggestions as to its suitability for specific purposes. Wherever possible, information as to the sizes in which the timber is usually available, and the approximate price at which each could be offered will be stated, and the principal reports of the Committee which have already appeared in the *Bulletin of the Imperial Institute* will be reprinted as an appendix to the list.—*Empire Forestry Journal* Vol. V, No. 1.

Rural India, Vol. II, Nos. 4 and 5, October and November, 1927, page 86, states that the Government of Madras has appointed a Committee to enquire into the improvement of the Co-operative movement in the Presidency. Mr. C. A. H. Townsend has been appointed President and Mr. G. H. Cooke, I.S.C., Secretary.

WEST INDIES ROOT DISEASE.

Root disease in the British West Indies and a note on Diaporthe perniciosa Marchal or a closely related species.

By H. R. Briton-Jones.

The binomial *Macrophomina Phaseoli* is used in this note in the full sense in which it has been recently established by Ashby (1), who cites the following synonyms :—

Macrophoma Phaseoli Maubl. (1905).
Sclerotium bataticola Taub. (1913).
Macrophoma Corchori Saw. (1916).
Macrophoma Cajani Syd. and *Butl.* (1916).
Macrophomina philippinensis Petr. (1923).
Rhizoctonia lamellifera Small (1924).
Rhizoctonia bataticola (Taub.) Butl. (1925).
Dothiorella Cajani Syd. and *Butl.* (1925).
Macrophoma Sesami Saw. (1922).

The fungus has, of recent years, claimed the attention of a number of mycologists in different parts of the world, and the claims put forward by Small (12-14) in his recent articles in *Tropical Agriculturist* are of special interest. Evidence is given in this note which supports Small's conclusions in many respects, except perhaps on the most important point of all, namely, the physiology of the parasitism of the organism in question.

Previous Work on Parasitism.

In 1913 Taubenhaus (15) discussing the pathogenicity of the fungus on sweet potato found that when inoculations were inserted into healthy sweet potato roots the typical charcoal disease is induced within three to eight weeks. No infection experiments on uninjured healthy roots are described.

In 1916 (9) Sawada stated in connection with jute disease that "manuring with wood ash lessens the disease not only because it supplies potash, but also kills the spores of the fungus in the soil."

In 1917 Martin (6) in describing inoculation experiments of fruits, stems and roots of peppers (*Capsicum annum*), states that "on the stems and roots the inoculations were not as successful as on fruits. Death of the plant or plant part resulted before the mycelium had advanced far from the point of inoculation. The cause of death was thus obviously due to some other factor."

In 1918 Butler (3) gave his opinion in regard to *M. Phaseoli* on adult cotton as follows :— (i) "As regards the form of attack on the mature plant, it is not certain how far *Rhizoctonia* is responsible for the observed conditions, or how far it is secondary to some more serious adverse influence." (ii) "The limited attempts that have been made, at Pusa, to reproduce the disease by inoculating large cotton plants with pure cultures of the fungus, have failed, and it is evident that if *Rhizoctonia* is the cause, some special conditions regulate its attack."

In 1924 Jacob (5) shows that "control measures based on the plentiful use of potash against the disease in jute have been successfully adopted."

In 1924 Shaw (10) described successful infection experiments on jute. Each plant was wounded by making a slight tangential cut on the stem surface at the point of infection. The infections were tied up with cloth, and the controls remained healthy. It is submitted that the difference in effect between the controls and infected in a case of this kind cannot altogether be put down to the action of the fungus. To consider, under such conditions, that the influence of the wound and the cloth is equal and similar in control and infected plants, is a fallacy. It is evident that the author realised that the results of his experiments were not applicable to field conditions because in his summary he states that "the amount of potash in the soil is a determining factor in the incidence of the disease."

It will be seen from the above that, apart from anything which the writer has to add, there has been considerable evidence put forward by different mycologists that the fungus *Macrophomina Phaseoli* becomes parasitic on adult plants only under special conditions. These conditions are such that they in themselves thoroughly upset the metabolism of the plant before it is attacked by the fungus. In other words, the fungus *Macrophomina Phaseoli* is itself a secondary factor in the causation of disease, and from the point of view of control, operations must aim at the elimination of these fundamental and primary factors. This will render the fungus, although it may still be present in the soil and distributed as spores, completely innocuous.

In his recent publications Small (12-14) in his eagerness to establish the fact that *M. Phaseoli* is, in his opinion, more important than the other fungi associated with root-rot in the East, has made statements which are not in accordance with the true facts. He states that the fungus *Macrophomina Phaseoli* is often the sole cause of disease, and adds that it has been found to be present in every case of supposed *Fomes, Poria, Ustulina, Rosellinia and Diplodia* disease that has been examined by him. He also includes (12) in the same category the fungus *Sphaerostilbe*. In regard to the control of the disease he points out the importance of the pycnidial stage because "if this is found to occur independently of the root Rhizoctonia form, it is possible that the focus of attention may have to be moved from the soil Rhizoctonia which causes root disease to the aerial pycnidial fungus which originates new centres of the Rhizoctonia in the soil and so distribute a harmful fungus." The following extract (14) is particularly interesting :—"Meanwhile, the only measure that can be recommended to the practical planter is that he should promote the health of the plants by all means in his power. Unfortunately, success in avoiding Rhizoctonia root disease cannot be guaranteed to follow that measure, for it is clear that healthy well-grown trees and bushes fall victims to the fungus, and

it is to be feared that they will continue to do so. In other words, there is no doubt that Rhizoctonia root disease will always occur when the fungus is present in the soil."

It is always sound to recommend the planter to promote the health of his crop, but it is difficult to understand why special reference should be made to it in connection with disease caused by *M. Phaseoli* if, as stated above, healthy plants will still be subject to its attack. Furthermore, it is significant that Small's ([11]) own infection experiments with coffee in Uganda were definitely negative.

M. Phaseoli in the West Indies.

The fungus was first recorded in the West Indies by Ashby ([1]) causing a storage rot of sweet potatoes in Trinidad. The writer has since found it associated with a root-rot disease of cotton and tobacco in Trinidad, and on lime trees in Dominica. The symptoms of the disease on the root-systems of cotton and tobacco in Trinidad are similar to those previously described on cotton, jute, and other plants. Its occurrence on lime will be dealt with later. The few cases of diseased tobacco were found growing in cotton plots, and were self sown. The name of the variety is unknown.

The following varieties of cotton have been found to be subject to the disease:—*Mead Cambodia, Trinidad Red x Kidney Upland, Sea Island A N, Sakellarides, Nanking, Dharwar American, Cawnpore (G. arboreum), Million Dollar, Buri from Nagpur, Upland x Cassava, and Prudhomme's Non-shed.*

An estimation of the extent of the disease on cotton was made on two plots at the Research Station of the Empire Cotton Growing Corporation. Roughly, one half of one small plot had been given, before planting, a dressing of manure from the cattle pen. The figures showing the distribution of root disease on this plot are suggestive. On the manured half there were 87 healthy cotton plants and not one diseased. In the unmanured half there were 91 healthy and 26 diseased. Of the 26 diseased, one showed the symptoms of *M. Phaseoli* only, 20 showed the symptoms of attack by *Rhizoctonia Crocorum* only, and 5 showed double infection by both these fungi. An estimation of the disease in Plot 3 which had been given no manure, showed its distribution to be patchy. Of the 2,888 plants examined, 843 were found infected with *M. Phaseoli*, *i.e.*: 29 per cent. of the total. A count on some plants of the variety Cambodia in a small plot at the Imperial College of Tropical Agriculture, showed that 11 were healthy and 17 diseased (*M. Phaseoli*). The majority of the healthy plants were at the end of the rows next to the donkey pen. Professor E. E. Cheesman agreed with the writer that although the plot was small, the influence of the seepage from the donkey pen on the incidence of the disease, was very clear.

Infection Experiments.

The results of infection experiments on seedling cotton by placing the fungus in contact with the seeds in the soil gave negative results. The plants were grown in kerosene tins of 4 gallons capacity. In one case the plants, after thinning to three plants per tin, were allowed to grow on to ascertain whether they would develop symptoms of disease as adult plants. The plants grew in both the control and infected, and produced flowers and bolls. When several bolls had opened, all plants were up-rooted and the root-systems of both control and infected plants were found to be in a healthy condition with no sign of root-rot. Later, another infection experiment was carried out using sterilised gravel instead of soil, and water which had been boiled and allowed to cool was used for watering throughout the experiment. Gravel was used as being probably deficient in potash and other plant food-requirements. The experiment was composed of a dozen pots of three plants each, and different treatment was given to each of six pairs. The first couple was given no special treatment and served as controls. The second couple was inoculated with *M. Phaseoli*. The third couple was given a dressing of 4 ozs. of sulphate of potash and no fungus. The fourth couple was given 4 ozs. of sulphate of potash and inoculated with *M. Phaseoli*. Similarly, the fifth couple was dressed with 45 grams of fresh sheep's manure and no fungus, and the sixth couple with the same amount of sheep's manure and inoculated with *M. Phaseoli*. The date of sowing was the 9th March, 1927. There was no apparent effect on the growth of the plants as the result of potash dressing but the plants treated with sheep manure were almost twice the height of the others and darker green. On the 13th May, 1927, when the plants were roughly two months old, one plant was lifted from each of the twelve pots. There was no sign of root disease. On the 10th June, 1927 (*i.e.*: 4 months after planting), all plants were finally raised and examined. No root disease was present in any but it was observed that all plants, with the exception of those which had been given sheep manure, showed cracks in the cortical tissues. The plants were lifted at 4 months old because the writer had to leave Trinidad on official business. Nevertheless, cases of diseased cotton plants less than 4 months have been observed in the field. This experiment has been described somewhat in detail because it indicates the lines on which further investigation of the parasitism of *M. Phaseoli* will be carried out in future.

Jute.

Infection experiments with *M. Phaseoli* isolated from cotton have also been carried out on adult jute plants growing in soil, but with negative results.

In a letter to the Imperial Bureau of Mycology, the writer informed Ashby that he intended inoculating jute stems with the fungus from cotton to see if it could be induced to form pycnidia. Ashby kindly replied by sending three pure cultures of the fungus isolated from the following sources for similar trials:—(i) a monospore isolation from bean stem (S. Carolina); (ii) a culture from sclerotia in the cortex of a lime root (Ceylon); and (iii) a recent isolation from a sweet potato sent by Taubenhaus as a typical case of charcoal rot in the U.S.A. The fungus isolated from Cotton in Trinidad was used together with the above three isolations for inoculation experiments on jute seedlings, and by insertion through wounds in jute stems at the time of flowering. The jute seedlings were grown in gravel sterilised in an autoclave, in tin cigarette boxes. Sterilised water was also used for watering. When the seedlings were well above the soil a small portion of a pure culture three days old (*i.e.*, actively growing and before sclerotia had been formed), of the four isolations of the fungus was placed near the seedlings in the boxes. The seedlings in two boxes were thus inoculated with each of the four isolations and two were left as controls, making ten boxes in all. The boxes were then placed under bell-jars where the air soon became saturated with moisture. All four isolations attacked and killed several seedlings, and although closely observed, there was no indication of any difference in virulence between the various isolations under these conditions. The controls remained free from the disease.

It is interesting to note that a similar experiment previously carried out with cultures five days old gave, in the majority of cases, negative results. This was probably due to the fact that the medium (potato) was covered with sclerotia, being quite black in colour, so that the growth of fresh hyphae was very feeble. It was also observed that the potato medium in one group of cultures turned pink internally in the case of some of the isolations and not in others. Fresh series of cultures were made on potato medium to see if this was a constant feature, and some of those isolations which had previously produced pinkish colouration failed to do so in the second series and those which had remained normal in the first series turned pinkish in the second. This may have something to do with the constitution of the piece of potato medium. Potatoes are very variable and are unreliable as a medium for comparing growths. The same phenomenon has been previously mentioned (3) in connection with the fungus isolated from cotton in Egypt.

Experiments on Adult Jute.

The isolations from cotton, lime, bean and sweet potato were inoculated through severe wounds into the stems of jute plants on the 6th April, 1927. Two control plants were kept at the commencement of the experiment and remained healthy throughout. The wounds were not bound. It might be pointed out, however, that in the second part of the experiment which was at first unforeseen, these control plants ceased to function as such. All the inoculated plants showed dark brown lesions extending slightly above, below and on the sides of the wounds three days after inoculation. The disease progressed slightly for two more days and was then cut off by callus formation. No further development was made, and so far as could be decided with a pocket lens magnifying fifteen times, no pycnidia were produced. Several weeks later no further progress had been made by the disease and in order to induce the formation of pycnidia it was decided to wound the plants still more severely by cutting longitudinally on several sides and through the lesions. The fungus grew rapidly into the injured portions in some cases, but in others more slowly. Later all the inoculated plants were cut down to half their height, and all leaves removed. This was followed by further and more rapid growth of the fungus in all the inoculated plants and pycnidia were produced just under the bark. Poured plate cultures were made from tendrils of spores examined microscopically and in each case the sterile *Rhizoctonia* stage with typical sclerotia were produced in culture. The pycnospores in all cases were found to agree in shape and size. Thus the isolations from cotton lime, bean, and sweet potato all produced pycnidia when inoculated into very severely wounded jute plants. Although the plants died following the treatment given, the experiment proves very conclusively that *M. Phaseoli* is a weak parasite of the adult jute plant.

An experiment on adult jute plants by inoculating the soil with *M. Phaseoli* gave negative results.

M. Phaseoli on Lime in Dominica.

Further work on cotton and jute had to be abandoned temporarily in order that a visit could be made to investigate the means of combating a serious epidemic of root disease in West Indian seedling lime trees in Dominica. Specimens had been previously sent by post to the writer and these had been identified as red root disease caused by *Sphaerostilbe* spp. Ashby has since informed the writer that the West Indian species of *Sphaerostilbe* is now considered to be *Sphaerostilbe repens*.

The whole question of the outbreak of root disease in Dominica is so complex that it is considered desirable in the first place to review briefly all root diseases of limes in the West Indies as they were accepted up to the time when Small's (12–14) publications appeared.

Rosellinia Diseases.

Two species of *Rosellinia*, namely, *R. pepo* and *R. bunodes* have been described as causing root-rot in lime trees and other plants in the West Indies. In the Laboratory of the Agricultural Department in Dominica, the writer was shown a recently collected specimen of lime

root with the white fans of mycelium which are so characteristic of *R. pepo*. A portion of a small root collected by the writer and incubated in the laboratory developed on its surface the conidial fructifications of *Rosellinia*. The white fans of mycelium were also developed, which showed that the species was *R. pepo*. It is interesting to note that the section of small root alluded to was obtained from a root-system the larger roots of which showed the rhizomorphs of *Spaerostilbe repens*.

Sphaerostilbe repens.

This is the fungus which has previously been held responsible for red-root disease in the West Indies. Although typical symptoms or the rhizomorphs of the fungus were found on all the root-systems examined with one exception, the writer's observations in Dominica have led him to the definite conclusion that it is not the primary cause of the disease. (*Vide* below.)

Collar Canker.

Nowell's description of this disease (7) is vague and in one of the Annual Reports of the Agricultural Department of Dominica (16) it is considered to be the same as root-rot or *mal di goma* (*Pythiacystis citropthora*). The writer found no trace of Collar Canker as a specific disease

Gummosis.

There are several diseases of citrus trees which come under this heading, but the symptoms of some of the cases found in Dominica resembled one of two, viz.:—*Pythiacytis citrophora* and *Phytopthora parasitica*. Nowell (2) states that "apparent instances of root-rot or *mal di goma* (*P. citropthora*) have been met with on lime in St. Lucia, Dominica, and Grenada." The symptoms of these two diseases are so similar that the writer would not be prepared to diagnose the one from the other without isolating the organism. Furthermore, the plant showing the primary stages of gummosis already alluded to might be taken for one of the above. (*Vide* below.) The extent of the trouble caused by one or more forms of gummosis in the epidemic in Dominica was one of several technically important points which could not possibly be solved in the short period of ten days which was the duration of the writer's visit.

So far as previous records in the West Indies go then, double and what *appeared* to be single infections of both the fungi *Sphaerostilbe repens* and *Rosellinia pepo* were found.

It is interesting to note, in connection with *Rosellinia*, that cacao and bread-fruit trees were found in many cases surrounded by dead lime trees.

(*To be continued.*)

[The Bibliography relating to the whole article has been published in this issue and will not be reprinted, but should be referred to when the remainder of the article is published.—Ed.].

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LOW PRICES FOR COTTON.

(*Concluded.*)

In the present state of the cotton market, it is of the highest importance to encourage our Empire growers to produce all that they can, but this is only the immediate necessity. Until they cease to depend upon one crop, and until cotton takes its proper place in a rotation of several crops, the position will not be quite stable, and much effort should be devoted to the careful study of the possibilities of other crops and of rotations.

While the cheap costs of production, and the higher prices obtained for Empire cotton, are great assets, the position will be much strengthened by careful attention to the other side of the balance sheet—the lowering of the cost of placing the cotton in Lancashire. Above all, cheap transport is the most crying need; it is at present more expensive and less efficient, than in America, though it is true that, on the other hand, the cotton is handled by fewer middlemen. Improvement and cheapening of the means of transport are the most urgent problems lying before those who wish to see great developments of the cultivation in the Empire. Ginning and other processes also require to be improved and cheapened, and there is still room for an improvement in the quality of the cotton. Even in a bad market there is never any difficulty in disposing of cotton of really good quality. Lancashire is perpetually tending to spin finer qualities of cotton, and wants all that she can get of these qualities. As Mr. Ormsby-Gore said at a recent meeting of the Council, the future is going to depend upon our turning out a cotton that is always at least 2*d.* on American middling; if we only produce a thing as good as the latter, we shall have a very bad time.

Various schemes are under discussion for ameliorating the position of the growers, but as these can only be put into operation by countries like the United States, that have the bulk of the supply in their hands, they have only an academic interest for us, though their adoption may be cordially welcomed as they all act to the good of the growers in outside countries, as well as within the lands of their origin. Such are valorization—the taking off the market in a bumper year of a considerable portion of the crop, and its marketing in a later year of short crop. This is practised by Brazil in coffee, and is about to be put into operation with the American cotton crop of the past season. It makes for stabilization of prices, and is all to the general good. Another is restriction of crop, as applied to rubber, but this, with an annual crop like cotton, is hardly practicable. Yet another is reduction of area, which is usually practised by the growers themselves, and which will probably happen this year in the United States. As already pointed out, this gives to our growers, who can produce cheaply, the greatest opportunity that has yet come their way, and every possible advantage of it should be taken. In this connection a quotation may be made from a *Times* editorial of last October:

"Clearly the world grows rich by the production of wealth; the unworked seam and the untilled field have potential rather than real value. The invention of a new machine which increases mankinds power of production adds to the productive wealth of the world, and enables a larger quantity of products to become available for consumption. It means, in short, that the inhabitants of the world have more to share, and so long as there are rivers to be bridged, railways to be built, or roads to be made, the work of the world is not done. So long as there are human beings insufficiently clad and ill-nourished the work of the world is not done. The difficulty is that we have not yet succeeded in creating perfect machinery for the distribution of the products of industry, and so, while farms are unprofitable and fields are untilled, children go hungry; while spinners, weavers, and tailors are out of employment, unfortunate persons shiver with cold.

"Obviously there is something wrong, but unfortunately the trouble has not yet been correctly diagnosed, and no real remedy has been found. Hence it comes about that an insufficient demand for goods—which in reality means that those who need them have not the purchasing power to obtain possession of them—results in factories working at less than full pressure, and many persons are out of work. Unfortunately an increasing number of persons think that the remedy for bad trade is to be found in limiting output to the existing demand. It is quite true that limitation of output may result in remunerative prices, but it is apparently not seen that the effect of the restriction of output is necessarily cumulative. The fact that fewer persons are employed entails further restriction of the demand for goods, higher cost of production per unit, and so on, in a vicious circle leading ultimately to greater poverty and distress. Years ago a well known writer, and others of his way of thinking, occupied a great deal of our space in endeavouring to prove that the remedy was what they termed the creation of credit, but we have seen where currency inflation led in the case of Germany, and there is every reason to suppose that currency inflation in any other country will have the same effect in the long run. But the failure of this gentleman and his friends to solve the problem is not a reason for adopting a policy of despair which is fundamentally unsound. Wider vision is needed. We do not profess to have a ready made scheme that will result in better distribution of the world's products, the stimulation of demands and general prosperity, but we are certain that, although restriction of output may in particular cases sometimes be justified as a temporary expedient, it can never afford a real remedy for present economic evils."

In conclusion, to enable the growers to take full advantage of the present position, some assistance may in certain cases be necessary, but such assistance must come from their local government which is fully conversant with the local difficulties. It is up to local authorities to decide whether, for example, reduction of taxation, special cheapening of costs of transport or of ginning, the supply of free, or cheap, seed, or other assistance may be necessary, and whether the general conditions of the country will allow of such assistance. An admirable example of what may be done is offered by the new sliding scale of taxation upon cotton in Uganda.

To sum up, the present low prices will test severely the possibilities of cotton cultivation in the Empire, but to our growers is offered such a chance of establishing themselves in a very strong position as will rarely come their way. Already they can produce more cheaply, and are turning out a cotton of better quality, and they should now try all they know to fill up the gap in production which is all but certain to follow the present excess. They, and those who are engaged in assisting them, must do all that they can to improve quality, and to lessen cost, and to find other crops that can be employed in rotation with cotton. The greater the success that attends these operations, the greater the progress that we shall make on the road to the desirable goal of stabilization of cotton prices. At a recent meeting of Council, Lord Derby, remarked that the large American crop of the present season had reduced prices to a level which could not have been foreseen a few years ago. Though this fact might cause a setback in the acreage under cotton in the Empire, he thought that where cotton was grown by natives on small plantations, this setback might not be prolonged. The need for a money producing crop was becoming increasingly felt by African natives, and they might learn from the drop in price that only improved methods of cultivation could ensure to them a sufficiently high yield per acre to bring them a good return for their labours. He emphasized the advantages which Lancashire might expect to derive from their continued support and encouragement of the cotton-growing industry within the Empire.

We may end by urging (if indeed it needs urging) upon spinners and manufacturers alike that a whole-hearted support of Empire cultivation was never more necessary than now, nor was it ever more likely to lead to results that will be eminently gratifying to all who are concerned in any way with the production of cotton within the Empire.—(*The Empire Cotton Growing Review* Vol. IV, pp.1-9.)

THE legend beneath the photograph of the Rugby Football Team on page xii, should read H. O. THOMAS, in place of L. Tucker.

THE PRINCIPAL'S REPORT, 1926-27.

(*Concluded.*)

Copies of the Prospectus for 1928-29, *the Principal's Report for* 1926-27 *and the Register of the Imperial College of Tropical Agriculture may be obtained on application from the Secretary, Imperial College of Tropical Agriculture,* 14, *Trinity Square, London, E.C.*3, *or from the Registrar, Imperial College of Tropical Agriculture, Trinidad, B.W.I. For the convenience of readers extracts from the Principal's Report for* 1926-27 *are published below.*

Coconuts.—A commencement has been made with the study of the cytology of coconuts, leave having been received to use the trees on a neighbouring plantation belonging to Mr. E. A. Robinson, who is one of the Governors of the College. The Mycologist has made a detailed investigation of the coconut wilt disease, and it is hoped to publish an account of it shortly. He is also taking up a study of the "leaf disease."

Minor Crops.—A study is being made of legume and forage crops, more especially with the object of finding a suitable cover or rotation crop for the cane areas as an aid to controlling Froghopper. The most successful of these is the Bengal bean (*Stizolobium*) which has this year been taken up by the cane planters on considerable areas. One or two promising type of soya beans have also been raised and will be continued under observation. Of the ground provisions, the sweet potato has received a good deal of attention. Many varieties have been carefully tested and selection work has commenced.

Soil Investigations.—The work started in 1926 on the physical properties and moisture contents of different kinds of laterite soils has had to be temporarily suspended, as the problems connected with the Froghopper blight have taken up most of the time of the staff. In addition to numerous field observations and soil sampling, the laboratory work has entailed work on the composition of various insecticides, the testing of electrode methods, the elaboration of methods for measuring soil textures, &c.

As stated above, it seems that this work is likely to lead to definite results. Mr. P. E. Turner, who has been seconded for special duty in connexion with the Froghopper investigation, has been going into the question of the base exchange of sugar-cane soils, and has also been examining soils with a view to tracing the fluctuations of various nutrients. Another officer (Mr. Follett-Smith) has been studying methods of cane leaf sap analyses.

The work on soil colloids has not been abandoned, but is being held in abeyance until circumstances and time permit of its resumption.

Tropical Sanitation and Hygiene.—An offer made by the Surgeon-General to the Trinidad Government, to place the resources of the Government Pathological Laboratory in Port-of-Spain

at the disposal of the professor of this department was gratefully accepted. As a result of this generous offer Dr. Seagar has been enabled to start a detailed study of the causes and incidence of nephritis and to continue his investigations into malaria and filaria and the problems that arise from their prevalence.

Scientific Papers.

The following papers have appeared during the year :—

Soil Science Department.

1. The Rôle of Aluminium in Soil Infertility and Toxicity. F. Hardy. *Jour. Agri. Sci.*, XVI 4, Oct., 1926, pp. 616-631.

2. The Measurement of "Suction Forces" in Colloidal Soils. F. Hardy. *Soil Science*, June, 1927.

Botany Department.

1. A Note on the Vegetative Propagation of Cotton Plants. S. C. Harland. *Empire Cotton Growing Review*, IV, 1 Jan., 1927.

2. On the Existence of Egg Laying Cycles in the Domestic Fowl. S. C. Harland. *Jour. Genetics*, XVIII, 1 March, 1927.

3. On a Progressive Variation with Age of a Simple Mendelian Ratio in the Cowpea. S. C. Harland, J. C. Haigh and J. V. Lochrie. *Genitica* VIII, 5 April, 1926.

4. Counted Grain Pollination in Mirabilis Jalapa L. S. C. Harland and J. C. Haigh. *Amer. Naturalist*, LIX, 672, Jan-Feb., 1927.

5. Fertilisation and Embryogeny in Theobroma Cacao L. E. E. Cheesman. *Ann. of Botany*, XLI, 161, Jan., 1927.

The question of the publication of scientific papers through the medium of "Memoirs" issued by the College was again considered, but pending the necessary financial provision such papers as have been prepared by the members of the College staff have had to be published in the standard journals.

Library.

The cataloguing of books has progressed steadily during the year with the help of rules and a classification scheme adopted on the lines suggested by Dr. Leake. For the five months ending 31st May, 1927, 200 new books have been entered and catalogued 2,000 parts of current periodicals have been received and 425 volumes prepared and bound.

The Sugar Factory.

The Factory was operated during the crop season of March, April and May of 1927. A total of 1,288 tons of canes were crushed, and in spite of the difficult weather cane was delivered regularly and in the required quantity to the mill.

The Factory which is run for instructional and experimental purposes cannot be expected to give financial results that will compare with those of a commercial factory. The cost of the cane, labour, material and commission on the sale of sugar came to £2,453, 1*s.* 3*d.* and the sales plus molasses sold and in store, amounted to £1,948 6*s.* 8*d.* As some of the expenditure on labour and material which amounted to £322 4*s.* 2*d.* must be considered as capital and therefore as non-recurring the real deficit works out at about £200.

From this year's experience it has been found that certain additions and improvements will be needed to add to the efficiency of the factory, and these are receiving attention.

Land.

The acquisition of an area of 250 acres or so to meet the expansion of work for experiment and research is a necessity and is receiving the attention of the Governing Body.

New Developments.

The allocation of a special grant by the Empire Marketing Board for banana research was announced during the year, and plans are now being drawn up for the erection of a cold storage plant and for the recruitment of the necessary staff.

Plans and estimates for a new Chemical block have been drawn up and approved, and work will be started as soon as possible. This will relieve the existing congestion and will free more space for the entomological and agricultural sections and give more room for the expansion of the Library.

The College has received a welcome gift of £1,000 from the Carnegie Corporation for the Library, and this will enable several very necessary alterations and additions to be made.

The Principal concluded his Report by thanking the planting community for the way in which they have assisted in the training of the students and in the researches of the staff, by giving access to their estates and affording every facility.

The following table records the consumption in lb. *per capita* from 1840 to 1924, of coffee, tea and chocolate in Great Britain.

	Population.	*Coffee.*	*Tea.*	*Chocolate.*	*Total*
1840 ..	26,487,026	1.08	1.22	.08	2.38
1850 ..	27,523,694	1.13	1.86	.11	3.10
1860 ..	28,778,411	1.23	2.67	.11	4.01
1870 ..	31,205,444	.98	3.81	.20	4.99
1880 ..	34,622,930	.92	4.57	.30	5.49
1890 ..	37,464,051	.77	5.18	.54	6.49
1900 ..	41,454,621	.70	6.07	.94	7.71
1910 ..	45,469,564	.80	6.31	1.50	8.61
1920 ..	46,089,249	.82	8.35	2.66	11.83
1921 ..	47,263,540	.81	8.68	2.36	11.85
1922 ..	47,263,530	.86	8.66	2.51	12.03
1923 ..	47,413,382	.94	8.61	2.45	12.00
1924 ..	47,413,382	.93	8.82	2.26	12.01

TROPICAL WORLD NOTES.

Fiji.

We learn that the prospects of the Sea Island cotton crop in Fiji this year are not so good, as was anticipated. The last season has been very wet and the present November, which is the best planting month has also been so wet, that little planting could be done. It is therefore anticipated that there will be a considerable reduction as compared with last year.

* * *

Zanzibar.

Reference has already been made in previous issues of *Tropical Agriculture* to the clove industry in Zanzibar. While a brief description of the origin of the industry will be found on page 74 of Volume II, its unsatisfactory conditions and the high costs of production were discussed on page 255 of Volume II. A summary of the state of the industry in 1924 was given on page 77 of Volume III.

During the past year the decline in the price of cloves has caused anxiety in Zanzibar. In 1923-24, when the crop was small, the Zanzibar price was Rs. 27·09 per frasila. The crop had doubled, however, by the end of three years so that the price in 1926-27 fell to Rs. 13·94. To assist the clove growers the Government intends to use part of the expected increase in revenue to reduce the clove duty to 15 per cent., while payment of bonus on production instead of on bearing trees is being considered, together with payment in cash instead of in kind by producers, which will effect considerable savings in handling. Producers have also established recently a Clove Growers' Association, with the full support of the Government. The Association has taken steps to control production, to improve marketing, harvesting and transport, and to fix wages and labour conditions—thereby reducing charges.

The Government has now begun negotiations with manufacturers of vanillin with a view to the supply of cloves at prices which will enable clove oil to compete with rival products. The Government has also suggested the grading of cloves in two qualities, (1) to meet the needs of the spice market, and (2) to meet the requirements of buyers who use cloves for other purposes. To safeguard the spice trade it is proposed to denature the second grade prior to export.

The most important indication of a realization of the weakness of the clove monopoly is the recognition of the value of the coconut and copra trade, which has shown marked expansion since the War. Between 1913 and 1926 the exports of copra have increased by 73 per cent. and the movement began in 1923, when the export was 9,400 tons. In 1926 it had grown to 12,800 tons. Standardization of the quality of copra is now receiving the attention of the Government. —(*Times Trade and Engineering Supplement*, Vol. XXI, No. 499.)

Rupee=1*s.* 4*d.*
Frasila=35 lb.

South Africa.

South Africa's total maize production during 1927 was 18,216,184 bags which is the third greatest crop on record. There was an increase of approximately 7,300,000 bags on the 1926 crop.

* * *

Uganda.

The Tororo-Mbulamuti-Jinja extension of the Kenya and Uganda Railway has been opened and large cotton producing areas of Uganda will thus be provided with a direct railway outlet to the coast. Hitherto communications from Uganda to the sea have been by way of steamer from one of the Lake Victoria ports and Kisumu, the former terminus of the Uganda Railway.

The new line which has been constructed from the 3½ million loan voted by Parliament in 1924 runs from Mbulamuti (a point on the short line running from Jinja, on Lake Victoria, to Namasagali, on Lake Kioga) through one of the main cotton producing areas to Tororo, near the Kenya border. The line then passes across the North Kairondo district of Kenya, and joining the Uasin Gishu Railway, connects with the old main line at Nakuru. Mblamuti is on the bank of the Victoria Nile and 106 miles from the Kenya-Uganda border.—(*African World*, p. 480, 7th Jan.)

* * *

British Honduras.

The wonderful possibility of the citrus industry as one of the staple agricultural developments in British Honduras is being gradually recognised, and the cultivation of the grape-fruit in particular is likely to be of great value both to the colony and the Empire. At the present time there exists on the banks of the Sibun River, a considerable number of seedling grape-fruit and orange trees and with the institution of a favourable agricultural policy the day is not far distant when the products of the citrus industry will eventually be exported on a fairly large scale. According to Mr. W. A. J. Bowman, in the course of an article prepared for the Belize Literary and Debating Club, British Honduras, the Stanocreek grape-fruit, which comes from the colony, has won a distinctive position in the London market, and its quality is second to none. It grows throughout the entire colony and is noted for its remarkable flavour and productivity. In regard to shipping the product to Great Britain, Mr. Bowman points out that it would be a most unwise and unprofitable venture to export without cold storage facilities. He also points out that grafted varieties of grape-fruit trees imported from the United States some years ago have done exceptionally well in British Honduras, and the yields in certain localities are remarkable. With mass production of this notable fruit, a large trade can be built up within the confines of the British Empire. British Honduras is also capable of producing limes and lemons, and Mr. Bowman says there is no reason why the colony should not obtain a share of the trade.—(*The Chamber of Commerce Journal*, Vol. LV, No. 728.)

Malaya.

The worst feature in British Malaya during 1927 has been the fall in the price of rubber, which, coupled with the lower export release has reduced spending capacity and has modified bazaar trade appreciably. Official trade returns are available only for the first nine months of the year, and from these it is gathered that the total value of trade, excluding parcel post, amounted to $1,576,345,739 showing a decrease of $176,463,795, compared with the value of the corresponding period of 1226. Imports, excluding parcel post, amounted to $762,263,206, or approximately $29,680,000 below the value for the first nine months of 1926. The aggregate value of exports, exclusive of parcel post, was $814,082,533, showing a decrease of $145,773,851.

The revenue of the Federated Malay States is regarded as of a highly satisfactory character. For 1927 the revised estimates amounted to $104,000,000, which surpasses by $1,500,000 the actual revenue brought to account in 1926, the total of which was itself a record for the Federation. The total expenditure during 1927 according to the revised estimate, will amount to $101,500,000 a sum which is covered by the estimated revenue for the same period with $2,500,000 to spare.

With regard to the Straits Settlements, it is estimated that the revenue for 1927 will amount to $34,336,480 and the expenditure to $41,833,576 so that the surplus on the year's working will be reduced by nearly $7,500,000. The surplus at the end of the year is, therefore, estimated at $55,000,000.

On the whole, the 12 months just ended have been mildly satisfactory for the merchants in Malaya, and the prospects are now better than they have been for a considerable time.

The total rubber shipments from British Malaya for the 11 months amounted to 339,137·29 tons against 354,526·02 tons for the corresponding period of 1926, of a declared value of $472,488,000 and $659,223,000 respectively. Imports of rubber from countries outside British Malaya amounted to 164,976·82 tons being an increase of 28,447·66 tons over the 11 months of 1926. Of the total exports the United States took 217,254·34 tons, compared with 229,939·68 tons during the similar period of the previous year, the United Kingdom 71,914·07 and 76,373·55 and the continent of Europe 25,177·40 and 24,714·24 tons respectively. —(*The Times, Trade and Engineering Supplement*, Vol. XX, No. I. 499.)

* * *

Mauritius.

It is reported that previous to this year Montreal had purchased Mauritian sugar through brokers in Great Britain which entailed an increase in price due to freight charges, wharfage and other incidental expenses. This year Montreal buyers went directly to Mauritius and purchased their supplies there, thus realizing a considerable saving. — (*Canada West India Magazine*, Vol. XVII, No. 2.)

Haiti.

Mr. Geo. N. Wolcott, Chief of the Department of Entomology, *Service Technique* of the Department of Agriculture, Haiti is the author of a hand book entitled "Entomologie d'Haiti, 1927."

The book is an elementary entomology intended for use by students, farmers and others interested in agriculture in Haiti. It deals, Part I, with insects, their anatomy, physiology and development; Part II, ecology of insects; Part III, the orders of insects and, Part IV, entomology for the Farmer.

The book is well printed (in French) and well illustrated, many of the figures being from original drawings by the author.

The production of a useful book of this sort dealing with the insects and the problems of their control in Haiti is an indication of the development that is taking place in the agriculture of the Island Republic.

The *Service Technique*, established about four years ago, appears to be the first organisation for the systematic development of agriculture in that island. Haiti appears to have great natural possibilities and the activities of a Technical Service, developing agricultural efforts and providing for education and guidance in agricultural matters, should prove to be a most useful influence in the development of the island.

As for the Entomology of Haiti, it is interesting to note that the Chinch bug (*Blissus leucopterus*). is recorded as a pest of sugar-cane, rice, maize and guinea corn in Haiti. This insect, one of the most serious pests of maize and other cereal crops in certain parts of the United States of America, has long been known to occur in the West Indies and Central America, where, indeed, it probably had its native home, but only within the past few years has it been known in sufficient numbers to become a pest in these localities. Recently in Trinidad it has been recognised as a serious pest of lawn, and pasture grass, and it is also reported among the insects attacking sugar-cane in Porto Rico.

In referring to the cotton stainer, the author mentions the staining effect of the excrement of this insect on the cotton lint, but no mention is made of the relation, which is now so well understood, between the feeding of the insect and the entrance of the organisms causing the internal boll diseases which are responsible for the great amount of staining and for the loss of so much cotton in certain places.

The Mexican bollweevil does not appear to occur in Haiti, although it exists in Cuba, which is so near; the pink bollworm is a serious pest of cotton.

The Coffee leaf miner (*Leucoptera coffella*) is not considered to affect the yield even when this pest causes abundant damage to the leaves.

The general nature of pest attack in Haiti is similar to that in the other West Indian Islands. Many insects recorded as attacking plants are the same species and in other instances related insects of similar habits are recorded.

COTTON PHYSIOLOGICAL PROBLEMS.*

By T. G. Mason and E. J. Maskell,
Physiological Botanists, Cotton Research Station, Trinidad.

(*Concluded.*)

Methods.—A strain of Sea Island cotton was used in our experiments, and sowings were made at fortnightly intervals, so that within limits plants of any desired size or age should be available for experiment at any time. The work consisted essentially in the analysis of samples of leaves, stems, and bolls collected at specified times from plants treated in certain definite ways. An important feature of the work was the determination of the concentration of sugar existing in the sap of the various tissues, as well as of the total amount of carbohydrate present. For this purpose a large fraction of each sample was frozen for twenty-four hours, and the sap, after thawing, then expressed by means of a powerful vice. In view of the importance of deciding between the alternative channels of transport in the stem—the bark and the wood—the bark was in all cases stripped from the wood and the two tissues analysed separately. The methods employed in sampling and in analyses are necessarily somewhat technical, and will not be considered here.

Diurnal Variations in Sugar Content.—The first series of observations consisted in analyses of sugar and of reserve carbohydrates in samples of leaves, bark, and wood collected every two hours over a period of twenty-four hours. It was found that in the leaf both sugar and reserve carbohydrates (mainly starch) fluctuate markedly, rising during the day and diminishing during the night. In the bark there are well-marked changes in total sugar concentration which follow closely on those in the leaf, with a "lag" of about two hours. This change in sugar concentration is not, however, accompanied by any appreciable change in the reserve carbohydrates of the bark. In the wood no appreciable diurnal fluctuation is shown either by the total sugar concentration or by the reserve carbohydrates.

Observations were then made every three hours over a period of thirty-six hours and gave similar results. In this second experiment bolls were treated as well as leaf, bark, and wood. The diurnal changes in sugar concentration in the boll were on the whole similar to those in the bark; the sugar concentration rose during the day periods and fell during the night, both rise and fall being about three hours later than the corresponding rise and fall in the leaves.

The general picture of sugar transport suggested by these observations is as follows. During the day, as a result of carbon assimilation, the sugar concentration in the leaf rises and causes an increase in the rate of export of sugar from the leaf to the neighbouring bark. In consequence there is a rise in concentration in the bark; this rise spreads by a process analogous to diffusion, though differing enormously in rate, to the bark of the main stem and thence to the roots, bolls, and other growing points.

There is, however, an alternative picture of sugar transport by which the facts can be explained. In this second picture the channel of transport is provided by a narrow zone in the outer region of the wood, through which a mass movement of sugar in solution takes place as a result of differences in tension of water in different regions of the stem. A series of experiments specially directed towards the problem of the channel of transport was accordingly carried out.

The Channel of Transport.—The first experiment was a study of the effect upon sugar concentration in bark and wood of interrupting the continuity of the bark tissues. The plants used were 3 to 4 feet high, and the stem for about 18 inches from the ground level was trimmed of leaves and branches. About midway in this region of the stem a ring of bark ½-inch wide was removed from half the plants. Subsequent collections of ringed and normal plants at intervals of 6 hours enabled us to follow the course of events consequent on this interruption of the bark. The effect of ringing was very marked. Above the ring the sugar concentration in the stem tissues rose rapidly above that in the same region of the unringed plants; below the ring the sugar concentration fell as rapidly below the normal concentration. The leaves 2 feet above the ring showed a rise in sugar concentration quite as well marked as the rise in the stem tissues just above the ring. These results are clearly what might be expected if transport occurs in the bark, and differences in concentration between different regions determine the rate of transport. The theory that transport takes place in the wood is not, however, necessarily excluded, since it is impossible to be certain that in removing the bark we are not interfering with the normal functioning of the wood. It has, in fact, been suggested that the function of the inner layers of the bark is to remove from the wood substances which might otherwise block the channels of transport. If this were true, complete contact between wood and bark would be essential for transport. We found, however, in an experiment designed to test this possibility, that sugar continues to pass down a stem through a region in which bark and wood are separated from one another by a ring of parafinned paper.

Finally, we were able to show that sugar will move downwards into a 7-inch flap of bark which is continuous with the bark of the stem at its upper end, but is separated from the wood

* It is hoped that a paper giving full details of the work undertaken and the results obtained, of which this memorandum is but a summary, may be published shortly in the *Annals of Botany*. In that case reprints will be sent to members of the Corporation's staff abroad and to any readers of the Review who indicate their wish to receive a copy; requests should be received not later than the end of the year.

throughout the whole of its length. The rate at which movement of sugar took place in this case was only a little below the rate of movement into the corresponding region of bark on the normal plant.

Having thus established that the bark forms the main channel of longitudinal transport, it was possible to explore further the accuracy of the general picture of transport suggested in the first instance by the results of the two diurnal series of observations, and to turn our attention to the movement of sugar from bark to boll.

The Growth of the Boll by Day and Night.—In studying the diurnal changes in sugar concentration in leaf and bark we found that sugar concentration in the bark is higher during the day than during the night. We should in general expect, therefore, that the rate of transport of sugar from the bark to the boll would also be greater during the day, and since at least 90 per cent. of the dry weight of the boll is derived from sugar, we might expect that the growth of the boll in dry weight should also be greater by day than by night. This possibility was tested by determining at 12-hour intervals the dry weights of large samples of bolls. The results showed a very striking difference between day and night growth, the average increment during the day being more than four times as great as the average increment during the night. The fact that the supply of sugar to the boll may be very much greater by day than by night is also of importance in connection with the phenomena of thickening of the cotton hair.

To return to the question of shedding, it has been suggested, for instance, that the shedding of young bolls, following a period of rain, may be due to a check in the supply of organic food to the boll as a result of the diminished carbon assimilation of the leaves in cloudy weather. The present results suggest that a reduced head of sugar in the leaf may, in fact, very rapidly result in a reduced rate of sugar supply to the boll. Whether all cottons are alike in this respect is not known.

Reverting to the more general problem of movement of sugar along the bark, several lines of work were followed in the attempt to establish whether the analogy with diffusion did indeed provide a sound basis for the interpretation of the phenomena. On the diffusion analogy reversal of the direction of movement is merely a question of reversing the relative position of source and "sink." We are able to establish the fact that sugar will move into the middle region of a stem either upwards or downwards, and some evidence was also obtained that the leaf, normally an exporter of sugar, could be made to import sugar.

The analogy with diffusion was also tested by experiments in which fractions of bark were removed. When a partial ring of bark is removed, leaving a strip or a "bridge" of bark intact, it is found that the total amount of sugar passing the construction in a given time is diminished, but not in proportion to the width of the amount cut away. For as a result of the partial block the sugar concentration above the "bridge" increases, while that below the "bridge" decreases, so that the gradient across the "bridge" becomes steeper, and the rate of flow across unit cross-sectional area of the strip increases. Evidence accumulated in this way strongly confirms the suggested relation between gradient in sugar concentration and rate of movement of sugar.

To sum up the results so far obtained: While the problem of the exact nature of the mechanism responsible for the high rate of sugar transport is still unsolved, the channel of transport has been proved to be the bark, and some of the factors responsible for alteration in the rate and direction of movement have been identified. It is clear, however, that this problem of transport of sugar is both complex and difficult, but upon its proper solution depends the elucidation of the apparently simple problems of shedding, &c. with which we started.—(*Empire Cotton Growing Review*, Vol. IV, No. 4.)

THE AMANI INSTITUTE.

The Amani Research Institute in Tanganyika is in one respect more fortunate than the Imperial College since, according to an interview with Mr. W. Nowell, its Director, it has an area of 750 acres ranging in elevation from 1,500 to 3,600 feet, while the Trinidad institution's great need is land. The Institute has been given a coffee plantation which formerly belonged to Prince Albrecht and used to produce 400 tons of coffee a year, but will not be specially concerned with economic results. It is to be staffed for fundamental scientific research into agricultural questions, this research being mainly on problems which, owing to the remoteness of the results obtained, would not be undertaken by agricultural departments, which usually have to see some immediate reward. All the Governments in East Africa have their own special agricultural departments. At Amani there is now one entomologist and a plant breeder. Several additional appointments are being made, and, when Mr. Nowell gets back early this year, he hopes to have at least eight scientific men engaged upon various special branches of research work. The Institute is supported by the Governments of Northern Rhodesia, Nyasaland, Tanganyika, Zanzibar, Uganda and Kenya and by the Empire Marketing Board.—(*The West India Committee Circular*, Vol. XLIII, No. 765.)

We have to acknowledge with thanks the receipt from Stewarts and Lloyds of their catalogue which is dated 1st January, 1928. The catalogue gives a brief account of the firm's recent development, present capacity and welfare work.

BANANAS AND CITRUS.

Report by Dr. Harland on his tour for the purpose of studying Bananas and Citrus.

(*Concluded.*)

SECTION VII.

BURMA.

I ARRIVED at Rangoon on 20th October, and first surveyed the fruit bazaars. Here I was much disappointed not to encounter any sign of Gros Michel, the only bananas on view being some small, very inferior types like the Trinidad Sucrier. I called on the Director of Agriculture on the 22nd, but he was away up country. Mr. Watson, the Deputy Director of Agriculture for the Rangoon district, was exceedingly helpful, however. On the 22nd he took me to see the Experiment Station, twenty miles from Rangoon. Work on rice breeding is the principal feature of this station, but there were twelve Burma varieties of bananas, not, however, in the fruiting stage. Mr. Watson advised me to go up country to Mandalay, where more information on bananas would be available.

On the 23rd I left Rangoon for Mahlaing, the site of another of the Department's stations. At about two in the morning we arrived at a station called Toungoo and discovered what appeared to be the Gros Michel banana being sold in quantities on the station platform.

From the 24th to the 27th October I stayed with Mr. T. D. Stoek at the Mahlaing Experiment Station. I was informed by the foreman of the Experiment Station that the variety picked up at Toungoo was widely distributed in Burma under the name of Thihmhwe ; it was said to be particularly abundant near Moulmein and was also probably present in Kyaukse, an irrigated tract between Tarzi and Mandalay. I saw another variety called the Wemelut, which was regarded as the same type but possibly smaller in size. It was considered that local variations existed in both varieties.

From the 28th October to the 2nd November I stayed at Mandalay with Professors McGibbon and Clark, of the Agricultural College. I made a thorough survey of the district, accompanied by Mr. E. R. Sawyer, Assistant Botanist, who proved a mine of information on the economic plants of Burma. We determined to survey the Toungoo district more thoroughly, and left Mandalay on the 3rd November, arriving at Toungoo at eight next morning. On the 4th November we visited the Toungoo fruit bazaar and saw two distinct types of Thihmhwe as well as what may be a new type of Canary banana. The Pisang Hijau of Malaya was also present fairly abundantly. A trip of twenty miles into the country was made in the hope of seeing Thihmwhe under cultivation, but we only saw small plants which, however, looked very much like Gros Michel. While in Mandalay and Toungoo an opportunity was taken to inquire about different varieties of limes and several new and promising types were collected in the markets. A consignment of limes has since been received from the Burma Department of Agriculture and some strong and healthy plants are now growing at the College. On the 5th November I left for Ceylon by the S.S. *Leicestershire*.

SECTION VIII.

CEYLON.

I arrived at Colombo on the 9th November, and after two or three days' study of varieties in the fruit bazaars I left for the headquarters of the Agricultural Department at Peradeniya. In Colombo I found only inferior types of bananas with the exception of a long thin type called the Anavalli.

From the 13th to the 25th November I stayed at Peradeniya with Dr. J. C. Hutson, who kindly put me in touch with the other officers of the Department, Mr. F. A. Stockdale, the Director of Agriculture being away on tour in India. Little interest had previously been taken in bananas by the local Department of Agriculture. The serious disease known as bunchy-top was widely distributed over the whole of Ceylon, having probably been introduced from Fiji some years previously. Bunchy-top is now considered to be some sort of Mosaic disease transmitted by Aphides or some other small sucking insect. I imagine it would be an excessively dangerous procedure to introduce any variety from Ceylon into the West Indies, without at least two years' quarantine. I was unable to get much additional information about bananas at Peradeniya but came to an arrangement with Dr. C. H. Gadd, the Mycologist, by which he promised to make further inquiries on the existence of varieties similar to Gros Michel. Altogether my sojourn in Ceylon was by no means satisfactory, so far as bananas and limes were concerned, but I spent a good deal of time studying the staple crops of Ceylon, rubber and tea, and gained much valuable knowledge of these crops.

I left Colombo for Marseilles on the 25th November, arriving in London on the 20th of December.

A Summary of Information Gained on Bananas and Limes.

1. The distribution of the Gros Michel and allied types ranges from Singapore through the whole of the Malay Peninsula, and extends northward into Upper Burma at least as far north as Mandalay. It is known in south Malay as Pisang Embon, and in the Penang district as Pisang Bunga. In Burma it is known under the name of Thihmhwe and is there present as a number of closely allied varieties.

2. Gros Michel is thus a native of south-eastern Asia, and how far it extends into Siam and Indo-China, on the one hand, and Assam on the other, is still not known. It is important, however, to trace further the exact geographical distribution of Gros Michel, for the wider the area from which

planting material is obtained, the greater the chance of getting favourable physiological variations.

I regard South-eastern Asia as the original home of the banana, principally owing to the wide diversity of types existing there, and further to the presence of several wild species of Musa.

3. South-eastern Asia is also probably the original home of the lime. The supposed wild form of the cultivated limes, *Citrus Hystrix*, is widely distributed in the foot-hills of the mountainous regions of Burma. Paucity of limes in Malay and the sudden increase in the number of types in Upper Burma leads one to believe that limes must have originated in some part of South-eastern Asia, though here again some information is required on the varieties of limes present in Assam and in Indo-China.

4. The original object of my visit to the East was to gain information on the original home of the Gros Michel variety of banana, and from what has been said above, it will be seen that this object has been gained. It is hoped that when the Eastern types of Gros Michel are imported into the West Indies that some of them may prove either immune to Panama disease or else highly resistant.

5. It is recommended that arrangements be made with the Department of Agriculture in Malay and Burma to send suckers of the varieties above-mentioned to Kew to be grown under quarantine.

6. It is recommended also, if possible, to induce these two Departments of Agriculture to grow a plot of the above varieties mixed with the two Trinidad seeded forms which hybridise readily with Gros Michel, in order that any resulting seeds may be shipped to Trinidad for sowing.

S. C. Harland.

RHODESIAN TOBACCO.

Mr. Cleveland gave a comprehensive review of the tobacco position at a special general meeting of the Rhodesia Tobacco Warehouse and Export Company in Salisbury which was attended by growers from all over the country. He said the increase in production of Southern Rhodesian leaf in two years had been 700 per cent., and this had necessitated the establishment of an organisation in England. The great need was to introduce Rhodesian tobacco and cigarettes to the home consumer, and this could be done through an advertising campaign. The Board of the company had informed the Government that growers would consider an excise tax on tobacco exported from Rhodesia for the purpose of advertising Rhodesian tobacco and suggested that the Government should supplement the amount so raised by an equal or greater sum contributed from general revenue. This proposal was now under consideration by the Government—(*The Times Trade and Engineering Supplement*, Vol. XXI, No. 498.)

CORRESPONDENCE.

Department of Agriculture,
Georgetown,
Demerara,
24th February, 1928.

The Editor,

Dear Sir,

In your March issue (page 59) there appears some notes on the re-organisation proposals of the British Guiana Department of Agriculture. As one or two suggestions are made before the full scope of the new organisation has been made apparent, it seems necessary to correct certain erroneous impressions regarding them.

First, in regard to the Botanic Gardens, no part of them is to be separated from the Department. Attention was drawn in the memorandum to the fact that the money spent on upkeep of roads and public pleasure grounds does not properly come under an agricultural vote.

In respect to the experimental and extension work, the agricultural area, I may state, has been divided into districts for the purpose of establishing Agricultural Stations. Two large and important ones are in charge of Agricultural Superintendents, located on the spot, in control of the work of their districts (District Agricultural Officers) and who are naturally the intermediaries between their Stations and Headquarters. For certain other stations, it will be impossible at once to utilise officers of the type of Agricultural Superintendents and it will be quite feasible for these to be staffed at first by officers of the Assistant Superintendent type under the immediate control of the Deputy Director. Financially, the Colony cannot afford at present the luxury of a large number of highly paid officers, although it is hoped that further development will justify all districts being in charge of senior men. So far as the Instructors are concerned there are already on the staff a number of these who have been trained under a local apprenticeship scheme. Some of these are very capable men doing good work in their districts, but admittedly the system requires considerable strengthening. A start has already been made by substituting for three part-time men one trained officer in the person of Mr. H. D. Huggins, late of the Imperial College, who will assist with experimental work at one of the stations and be utilised as well in taking the "good news" to the farmers in the surrounding area. Thus we are establishing precisely the same system in regard to extension as that put forward by the author of the notes in question, only on less pretentious lines compatible with the resources at our command.

In connection with the suggestion that the Sugar Experiment Station be placed in the same category as the District Agricultural Stations, anyone who is familiar with conditions of cane-growing in British Guiana and appreciates the history of the existing station will realise that this is entirely out of the question and altogether untimely. British Guiana is neither a Gold Coast nor a Nigeria, nor even an India (although East Indians form a large percentage of its population), and to adopt similar methods *in toto* would be to spell disaster at the outset. As it is, a splendid start has been made and a happy feature is the noteworthy response on the part of the Colony's agriculturists, both large and small.

Yours faithfully,
(Sgd.) J. SYDNEY DASH,
Director.

PEASANT PROPRIETORSHIP.

Although many well meaning, though not invariably well calculated, political expedients have been evolved to encourage the development of peasant proprietorship in the tropics, and in spite of the fact that a voluminous literature exists upon the subject, little attention hitherto has been devoted to an analysis of the relative economic, social, and other factors, typical of various sized holdings. We are, in fact, practically devoid of that knowledge essential to a correct appreciation of the complexities of the problem.

Mr. P. J. Thomas, Lecturer in Economics at Ceylon University College, recently delivered an address, the title of which—"Peasant Proprietorship in its Economic Aspect"—promised a valuable contribution to one aspect of this highly important subject. Unfortunately he fails signally to implement this promise

From the economic aspect the lecturer is despondent of the prospects of peasant proprietorship, "production" being, in his opinion, its "weakest point." Large scale methods necessarily result in lower unit cost of production though in agriculture, unlike manufacturing industries, factors exist which restrict the advantage of the large unit. He adds, "in industry the growth of the unit might be accompanied by increasing returns, but in agriculture the niggardliness of nature inevitably brought diminishing returns instead, although improvements might for a time put off this tendency." If the lecturer regards the theory of "diminishing returns" as an historical concept one is forced to the conclusion that, either nature is not so "niggardly" as he imagines, or, that "improvements" have been remarkably effective in "putting off the tendency." As variously interpreted by Mr. Thomas the theory of diminishing returns contradicts not only itself but also facts.

The nearest approach he makes to a consideration of the subject lies in his statement that in certain forms of farming such as "milk production, vegetable growing, fruit farming, poultry keeping, wherein machinery plays a relatively small part and close personal supervision counts for much, the small holding has succeeded and is bound to succeed." This statement has to be qualified, however, on account of the fact that "personal care cannot make up for the lack of capital and enterprise . . . . . But the principle of co-operation has come to their (peasant proprietors') rescue . . . . . There is no doubt that on the whole co-operation is the greatest hope of the peasantry in every country and in all circumstances." This is a sweeping statement, the universal validity of which the present writer begs leave to doubt. In certain countries and under certain circumstances, the various forms of co-operation are of great value, but there are cases in which other forms of organisation are more economical. Co-operation is not, as Mr. Thomas appears to believe, a panacea for all the peasant proprietors' ills. This blind enthusiastic faith in co-operation has resulted, in the present writer's opinion, in irreparable harm to co-operation, and has aggravated the evils it intended to alleviate.

The lecturer urges, however, that economic considerations are not the only criteria by which peasant proprietors should be judged. Peasant proprietors form the best barrier against revolutionary change, are essentially conservative, are jealous of old customs and institutions, are not easily cajoled into new fangled ways, and supply the best soldiers and sailors. Apart from the last statement, which is open to question, all the arguments which he adduces in favour of peasant proprietors might equally well be adapted, under certain circumstances, as arguments against. But he claims, even further, that the morality of the countryside redresses the evils of the cities. "The seething masses of the great cities have little moral stamina, but the countryside makes up for the city's backslidings." This is an aspect of the question upon which the present writer does not feel competent to express an opinion.

To sum up, we learn that as an economic unit the peasant proprietor is in a hopeless position, but that large units inevitably bring diminishing returns, and that in certain types of farming the peasant proprietor is bound to succeed, while co-operation can remedy all the defects of the small holdings. In the throes of an acute attack of mental indigestion we are relieved to learn that the lecturer recommends "a greater diversity of tenure and types of holding" as a means of strengthening national life.

The object of the reviewer in calling attention to this address is to emphasize that "damnable iteration" is no substitute for evidence, and to approve of Mr. Stockdale's observations that we are "confronted with the problem with no basic data to work on." It is to the provision of this "basic data" that the economist should direct his attention.

C. Y. Shephard.

We acknowledge with thanks the receipt of the first three numbers of a series of *Publications of the Hartley Botanical Laboratories*, in which it is the intention of the Department of Botany of the Liverpool University to publish twice yearly the results of a number of its investigations. The papers are excellently printed and illustrated, and the series should prove a notable addition to the standard botanical literature of the day.

CONTRIBUTIONS.

The Editor is prepared to consider signed articles for publication in *Tropical Agriculture*. Such articles should normally vary between 1,000 to 6,000 words and may be illustrated if desired. Rates can be obtained on application to the Editor.

MYCOLOGICAL NOTES.

Observations on a Fungus Disease and an insect pest of cotton by H. K. Hewison and J. E. Symond, Emp. Cotton Grow. Rev., Vol. V, No. 1, pp. 48-53.

Whilst the authors were resident at the Imperial College of Tropical Agriculture (1926-27), they made a detailed study of certain physiological questions appertaining to the cotton plant with a view to ascertaining whether (i) There was any difference in the degree of susceptibility between the five varieties Sea Island, Red Kidney, Ishan, Cawnpore and Sakellarides to (*a*) Dysdercus attack and (*b*) *Alternaria Longipedicillata*. (ii) External factors affecting the growth of the different varieties also affected the liability to attack by *A. Longipedicillata*. For this purpose the different cottons were grown in small blocks on the chequer board system with several repetitions of each variety.

A. Longipedicillata.

Commenting on Faulwetter's statement regarding this fungus, viz. :—"Artificial inoculations show the fungus to be a weak parasite, and able to infect healthy tissue only under the most favourable conditions" the authors state that "such a statement leads one to the conclusion that those plants of this experiment which were affected were growing under conditions which were either (*a*) not optimum for the particular plant concerned, or (*b*) extremely favourable for the spread and development of Alternaria. It would probably be more correct to assume a combination of the two." The authors conclude that while incidence appears directly correlated with lack of vigour, it is not necessarily inversely proportionate to maximum growth, but rather to optimum growth. Many plants growing vigorously during this period, in a condition compatible with a low carbohydrate-nitrogen ratio, were markedly subject to attack. Whether this is attributable to the internal constitution of the plant or the same external factor or factors associated with abnormal vegetative growth it is impossible to say. They found that in the variety Cawnpore the degree of attack was low as compared with the others.

Dysdercus.

The table giving the different degrees of attack on the various varieties sown on different dates shows that there was a decided preference during the first month for the Asiatic variety Cawnpore. There was little difference in the moderate infection of Sakel, Sea Island, and Ishan, whilst the Red Kidney appears to have a comparative immunity. It is pointed out that this order of infection is readily accounted for by the degree of maturation of the varieties of cotton, the Asiatic type ripening earliest, whilst Red Kidney, a tree cotton, is late in development. The authors are of the opinion therefore, that it cannot be said that there is any difference in degree of susceptibility to attack amongst these varieties of cotton, all becoming infested on maturity.

H. R. B-J.

REVIEWS.

Mycorrhiza. By M. C. Rayner, D.Sc., New Phytologist Reprint, No. 15. Wheldon & Wesley, Ltd., London, 1927. pp. 246. Price 21s.

This volume is a convenient collection in one cover of a series of papers on the non-pathogenic infection of higher plants by fungi. Herself a notable contributor to modern knowledge in this field, Dr. Rayner has reviewed her subject historically and critically on a scale which is indicated by the twenty closely-printed pages of bibliography, and produced an exemplary specimen of those digests which are becoming increasingly essential to non-specialists as the bulk and range of scientific literature continue to expand.

The papers are written for botanists, and hence are technical in form, but they are readable by any student with a moderate equipment of botanical knowledge, and well worth the reading.

The widespread occurrence of fungi within the roots of other plants, apparently without inconvenience—and in some cases with obvious advantage—to the host, is now recognised, and quite apart from the extraordinary interest of such cases as that of the orchid Gastrodia (which does not flower unless infected with a fungus that on other plants is a most destructive parasite) it has become a problem of the first importance to determine more precisely the nutritional relations between these fungi and the species which they infect.

As in so many other lines of scientific enquiry, data for the Tropics are scanty. If and when some of our major tropical crops are shown to be mycorrhizal, which is a possibility by no means remote, our knowledge of their physiology, and hence of their agricultural requirements, will make a long step forward.

E. E. C.

* * *

Sugar-Cane Varieties.—Volume XI of the *Journal of the Department of Agriculture of Porto Rico*, consists of a Monograph of Sugar-cane Varieties by A. H. Rosenfeld of the Insular Experiment Station.

This incorporates and extends previous work by F. S. Earle published in the same Journal in 1919 and 1921, and may thus be regarded as a revised edition of Earl's well-known monograph.

The purely descriptive portion of the present work extends to well over two hundred pages, and is profusely illustrated with excellent photographs and coloured plates.

In view of the amount of work which has been done on sugar-cane in Porto Rico, and of the fact that most of the standard varieties of other cane-growing countries are included, no technical officer interested in cane agriculture should be without a copy of this volume available for reference.

E. E. C.

Migration in its Various Forms. League of Nations, Geneva. Price 9*d*. pp. 28.

This publication gives figures relating to oversea and continental migration under the separate headings; Magnitude and direction of migration streams and Age, Sex, and occupation of emigrants.

G. W.

* * *

Fertilizer Requirements of Tropical Plants and Soils.—By A. Jacobs and V. Coyle. The Potash Supply Company, Eastcheap, London.

This book is a collection of articles which mainly discuss the value of potash fertilizer salts in the successful growth of various tropical crops, such as grain crops, tobacco, leguminous plants, olives, tea, coffee, sugar-cane, fibre plants, palm trees, root crops, vegetables and fruit crops. Throughout, the subject matter is presented in a restrained and sound manner, and overstatement of fact or theory is everywhere avoided. This is a praiseworthy feature of the book. Preliminary chapters on the fertilizer requirements of tropical crops and soils, on fertilizers available in the tropics, and on the determination of fertilizer requirements of tropical soils, are brief and to the point. The last-named chapter clearly distinguishes between precise quantitative field experiments, such as should be carried out in scientific research institutes, and qualitative fertilizer trials that may be laid down on plantations by planters. The book can be recommended highly to students of tropical agricultural business.

F. H.

* * *

An Introduction to the Study of Prices, Walter T. Layton, m.a., Macmillan & Co., Ltd. London. pp. viii+194. Price 7*s*. 6*d*.

An understanding of the relation between money and prices is essential to those interested in trade particularly to those who are given to drawing deductions from price and production graphs without correcting for changes in the purchasing power of money. In the opinion of the reviewer, economic theory is sounder in the sphere of money, prices, and exchange, than in many other sections, and the present work gives that background of fact to the theory that is now regarded the line to be taken up by economists. The first edition was issued in 1912 and immediately became a necessary book, it was reprinted with additional chapters and statistics on recent wholesale and retail prices, currency and wages in 1920 and 1922. As a whole the work serves to introduce the readers to current economic ideas as to the causes which determine the purchasing power of money and it contains historical chapters which give an adequate commentary on the price charts of the 19th century at the end of the book.

G. W.

BOOKS RECEIVED.

We have to acknowledge the receipt of the following books:—

AGRICULTURE.

Agricultural Geology. J. E. Marr, pp. 316, *Methuen & Co.*

Seed Testing. J. S. Remington, pp. 144, *Sir Isaac Pitman & Sons*, 10*s*. 6*d*.

BOTANY.

Enzymes. S. Waksman and W. C. Davison, pp. 364, *Ballieré Tindall & Cox*, 25*s*.

CHEMISTRY.

Lime and Magnesia. N. V. S. Knibbs, pp. 306, *E. Benn*, 30*s*.

The Chemistry and Examination of Edible Oils and Fats. G. D. Elsdon, pp. 522, *E. Benn*, 45*s*.

Lecithin and Allied Substances. K. Maclean and Ida S. Maclean, pp. 220, *Longmans Green*, 10*s*. 6*d*.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry, Vol. II. J. W. Mellor pp. 894, *Longmans Green*, 10*s*. 6*d*.

ECONOMICS.

Economic Aspects of Cane Sugar Production. Francis Maxwell, pp. 200, *Norman Rodger*, 12*s*. 6*d*.

Yearbook of Agricultural Co-operation in the British Empire, 1928. The Horace Plunkett Foundation, pp. 456, *G. Routledge*, 10*s*. 6*d*.

The Industry and Trade of Japan. S. Uyehara, pp. 326, *P. S. King & Son*, 15*s*.

Scientific Management in Europe. Paul Devinat, pp. 270, *International Labour Office*, 4*s*.

Agricultural Problems in their International Aspect. pp. 662, *International Institute of Agriculture, Rome*, 16*s*.

Kenya from Within. W. McGregor Ross, pp. 486, *George Allen & Unwin*, 18*s*.

GENERAL.

Nelson's West Indian Readers, Introductory Book, J. O. Cutteridge, pp. 100, *Thomas Nelson & Sons, Ltd.*, 1*s*. 2*d*.

Old Trades and New Knowledge. Sir Wm. Bargg, pp. 266, *G. Bell*, 8*s*. 6*d*.

The Students Guide to the Libraries of London. R. A. Rye, pp. 580, *University of London Press*.

TECHNOLOGY.

The Microbiology of Cellulose, Hemicelluloses Pectins and Gums. Dr. A. C. Thayson and H. J. Bunker, pp. 364, *Humphrey Milford*, 25*s*.

ZOOLOGY.

Composition and Distribution of Protozoan Fauna of the Soil, H. Sandon, pp. 238, *Oliver & Boyd*, 15*s*.

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

The principle of bagasse treatment with hot media.

A paper by V. Khainosvsky (*Arch. Suikerind.* 35, 811-34 1927) gives a brief sketch of the history of hot maceration. Two types of equipment which have lately been tried out in Java are described and illustrated. One of them has not been very successful in operation. The other, devised by Nöbel, is being installed by other factories. Here the carrier between the last 2 mills is completely enclosed to prevent losses of heat and of material. It runs only one-fourth as fast as an ordinary carrier, and the bagasse layer is four times as thick. Hot water is applied near the highest point of the carrier, next to the last mill. It passes through the layer of bagasse directly underneath, and the juice is caught in a small tank where it is reheated and limed. Then it is pumped back above the carrier to a point a little further removed from the last mill, and the entire operation is repeated several times. Finally the juice is used for imbibition. The macerator may be used not only in front of the last mill, but also in front of the one next to the last. It remains to be seen whether the increased extraction more than pays for the cost of operation. It appears strange that hot water should do better than cold because it has always been supposed that all the cells of the cane are ruptured by the heavy milling pressures used. Therefore, new plasmolysis experiments were made, with improved technique, and they have shown that bagasse contains many living cells. The experiments are illustrated by photomicrographs and micro-films. An explanation is offered for the presence of living cells, based on the mechanics of milling and taking into consideration also the hydrostatic pressure exerted by the extracted juice. About 25 per cent. of the total sugar in bagasse is contained in the living cells. This was proven by extracting the juice from the open cells with cold water alternately applying vacuum and pressure in rapid succession. It follows that, to extract all the sugar, it is necessary to kill the living cells by heating to at least 50°. In practice this is not easy to do, because heat penetrates bagasse very slowly. It would be best to agitate the bagasse in hot water, or use other means by which the water is thoroughly mixed with the bagasse. It would also be well to remove the air bubbles which keep the water from entering the bagasse. The heat treatment might not be applied just to final bagasse, but directly after the first mill or even after the crusher; here the use of steam may be preferable. The counter-current principle should be applied throughout. The heat treatment has the further advantage that it weakens micro-organisms and enzymes. A number of variations suggest themselves for the heat treatment of bagasse. It remains to be seen, however, how it will affect the mechanical properties of the bagasse, as it is quite possible that treated bagasse may cause difficulties in milling. Suggestions are offered for the possible solution of these problems also.—*Sugar*, Vol. XXX, No. 1, p. 27.

* * *

pH and Clarification.

The following summary is given of the trend of the relation of pH to clarification of cane juices as established by investigations in Hawaii, [W. R. McAllep, in Proc. 2nd Conference Int. Society Sugar-Cane Technologists, 1927, pp. 198-200.]

(1) Mechanical increase in purity; the apparent increase in purity caused by the removal of suspended matter by filtration with filtercel increases from 0·3 to 1·0 as we increase the pH of the clarification.

(2) Apparent purity; a fairly regular increase is obtained until just on the acid side of phenolphthalein neutrality, after which there is a decrease.

(3) Gravity purity (sucrose divided by brix) changes in a manner similar to apparent purity except that the maximum is reached at a slightly lower pH and the increase is slightly smaller for any given reaction. There is no definite correlation between increase in purity and the purity of the original juice.

(4) Glucose; a slight increase is noticed at low pH values, changing to a decrease at 7·2 or 7·3 pH. (The time required for heating varied from 10 to 15 minutes.)

(5) Lime salts; at first sometimes an increase is noticed and sometimes a decrease, but on the average there is not much change until about 7·2 or 7·3 pH; then a moderate increase occurs up to about 8·3, after which the increase is rapid.

(6) Volume of settlings; this becomes greater as the pH increases, except as noted under the next item.

(7) Clearness of settled juice; this improves as pH increases, nearly up to phenolphthalein neutrality. Some juices again cloud up above 8·5 or 9·0 pH; when this happens the volume of settlings usually decreases.

On the basis of these conclusions the Hawaiian experiment station advises liming to between 8·0 and 8·3 pH. In practice this cannot be done at all times because the filter presses cannot handle the increased volume of settlings. However there has been an increase in the amount of lime used in Hawaiian factories since this investigation was undertaken, and this has been accompanied by improvements in the recovery. These improvements have been due as much to the reduction in inversion losses as to the better increase in purity.—*Facts About Sugar*, Vol. XXIII, 5, p. 107.

The Editor is anxious to trace the name of the person who sent a 6s. postal order from Port-of-Spain on the 15th February. The postal order is numbered A/2 12682.

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

Present Status of Coal By-product Nitrogen.

Within the past 15 years, coal has been a very important factor in the competition between synthetic nitrogenous fertilizers and natural Chile nitrate. In the synthetic processes, coal has furnished a main source of power; coal has been used to convert steam into hydrogen for conversion into synthetic ammonia, and coal distillation has yielded ammonical by-products, from which ammonium sulphate is manufactured.

The world consumption of nitrogen in the form of various nitrogenous fertilizers was about one and one-third million short tons for the year ending July, 1927. Of this, 24 per cent. was sold in the form of coal by-product ammonium salts. This amount represents 310,000 short tons of nitrogen which is a marked increase over 300,000 tons used in 1926, and 275,000 in 1925. The average price of by-product ammonium sulphate in 1927 was 2½ cents a pound.

There have been no startling new developments in the methods used for manufacturing coal by-product ammonia, but larger scale working has been favoured. Bigger and more efficient coke ovens have been built. The newest of these will take a charge of nearly twenty tons of coal.

In spite of increased output of synthetic and by-product nitrogenous fertilizers, consumption is still increasing, and it is likely that keen competition between the various processes now employed will still further reduce the price of nitrogenous fertilizers during the next few years.—(*Indus., Engin. Chem.*, Jan., 1928, p. 80.)

* * *

Milorganite; A New Manure.

This nitrogenous manure is a product of a new activated sewerage sludge plant erected at Milwaukee, U. S. A. This plant was designed definitely to separate the sewerage of a large city into pure water and dry fertilizer material. Attempts to attain this object in other places, and by other processes, apparently have not proved successful. The fertilizer product is finely ground, and has the appearance of dried coffee dregs. It contains also 5·4 per cent. of nitrogen, of which 0·3 per cent. is water soluble. It contains also 3·1 per cent. of phosphate, of which 2·4 per cent. is easily available. The high content of organic matter (some 85 per cent.) renders the new material of great value when applied to light, unabsorptive soils.

The manure compares favourably with dried blood, fish-scrap, meat-tankage and cotton seed meal.

At present, some 2,500 short tons of Milorganite are produced monthly from a daily supply of 80-million gallons of Milwaukee sewerage. The output will be about 35,000 tons in 1928. The material sells very readily. The average price per short ton, *f.o.b.*, at Milwaukee, has been $15.00, which is about three-quarters of a cent per pound.—(*Indus. Engin. Chem.* Jan., 1928, pp. 4-10.)

* * *

Chlorosis in Relation to Iron and Manganese.

In *Soil Science*, 1926, Vol. XXII, pp. 437-446, Drs. Gilbert, McLean, Forman and Hardin, of the Rhode Island Experiment Station, U.S.A., describe the results of their investigations on chlorosis in crop-plants growing in heavily limed soil. Leaf analysis gave conflictory results, and proved not to yield a reliable index of the factors responsible for chlorosis. Thus, whilst the iron content of chlorotic plants was found to be less than that of normal green plants growing on limed soil, both kinds of plants were found to contain a greater proportionate amount of iron than plants growing on an acidic soil. The reverse result would have been expected. Many instances were recorded where chlorotic plants contained more iron and magnesium than healthy green plants, so that the abnormal condition could not be attributed in these cases to deficiency of either iron or magnesium.

During 1925, various treatments were applied in attempts to overcome the chlorotic condition. It was eventually found that small amounts of manganese salts effected a remarkable cure. The best results were obtained by the use of manganese sulphate, applied either to the soil, or to the leaves as a spray solution.

* * *

World Output of Fixed Nitrogen.

The report of the British Sulphate of Ammonia Federation for the year ended 31st May, 1927, shows that the production of fixed nitrogen declined from one and a third million tons in 1925-26 to about one and a quarter million tons in 1926-27, owing to a decrease in the output of Chile nitrate. Consumption increased, however, some 4 per cent. (compared with 10 per cent. in the previous twelve months). The following table shows the quantities of the various commercial fixed nitrogen fertilizers produced in 1926-27.

	Tons.
Ammonium sulphate—By-product	303,200
Do. —Synthetic	300,000
Calcium cyanamide	180,000
Nitrate of Lime	81,000
Other forms of synthetic nitrogen	133,400
Other forms of by-product nitrogen	40,300
Chile nitrate	199,600
	1,237,500

—(*Journ. Soc. Chem. Indus.* p. 1089.)

COLLEGE DINING HALL.

Photograph by *L. Tucker.*

The Hall is described on page 99.

IMPERIAL COLLEGE RUGBY FOOTBALL CLUB, 1927-28.

Photograph by L. Tucker

First Row: A. F. W. Sheffield, J. L. Greig.
Second Row: H. C. Taylor, C. B. Taylor, J. D. Broatch, N. V. Rounce (*Captain*), E. W. Leach, A. H. Savile, G. Cowan.
Third Row: J. E. Bruce, A. K. Briant, G. N. K. Turnbull, H. P. Smart, A. C. Bebbington, C. L. Skidmore, E. B. Martyn, O. J. Voelcker.

SPORTS.

Rugby Football Club, 1927-28.

[*We publish below a retrospect by Mr. N. V. Rounce, Captain of the College X V, of the* 1927-28 *Rugby season. A photograph of the team will be found on page xii.*]

The College Rugby Football Club is to be congratulated on its particularly successful season which has just come to a close and which, with its list of victories has eclipsed all previous records made by the Club. Of the eight matches played only one was lost and the high aggregate score of 109 points as against 13 was made. Of the victories, four were registered against the Trinidad Rugby Club, two against the Southern Rugby Club and one against H.M.S. *Wistaria*, while the Club was defeated once by the Trinidad Rugby Club after a very hard game. The team has undoubtedly been above the average for keenness and consistency of play while it is much to their credit that their own goal line was only crossed three times during the season.

Three members of the XV, Greig, Bruce and Sheffield were new to the game, but they all acquitted themselves well, particularly Greig in the responsible position of scrum half. Briant played a very safe game at full back and could always be relied upon to open up the game when occasion permitted. Broatch, as fly-half, was brilliant in attack and with the help of his swerve and a good turn of speed scored many spectacular tries. In spite of MacDonald's inability to play, the three-quarter line composed of Skidmore, Savile, Turnbull and Bruce proved very effective. Their defensive powers were however only tested once to any extent when the Trinidad Rugby Club defeated the Club on 20th December. Savile was the only consistent straight runner of the side and scored his quota of tries. Of the forwards, Colebrook Taylor hooked extraordinarily well in every match until he left for Fiji, and together with C. B. Taylor and Bebbington made up a very sturdy and useful front row. The backing up, however, with the exception of Taylor and Cowan was not good, but was excusable in the heat in which the matches were played. Leach played a solid game in the second row and did much to hold the scrum together, while Smart did excellent service as wing forward. The forwards as a whole showed great endurance and are to be complimented on their staying powers. The thanks of the Club are due to the Principal and the Dean for their continued interest in the welfare of the team and their willingness in carrying out the arduous task of refereeing on many occasions. The Club also is much indebted to Mr. Evans for his gift of a pair of goal posts and trusts that its gratitude may be gauged by the way in which they were defended. Every match was thoroughly enjoyed and the Club is particularly grateful to the Trinidad Rugby Club team for the splendid contests which they provided during the season.

The following played :

Full back :
A. K. Briant.

Three quarters :
A. H. Savile, G. N. K. Turnbull, J. A. MacDonald, J. E. Bruce, J. de la Bastide.

Halves :
J. D. Broatch, J. L. Greig, J. H. Palmer.

Forwards :
A. C. Bebbington, G. Cowan, E. W. Leach, E. B. Martyn, A. F. Sheffield, C. L. Skidmore, H. P. Smart, C. B. Taylor, H. C. Taylor, O. J. Voelcker, H. R. Hosking, N. V. Rounce.

Appended herewith is a list of matches played :

21st Oct.,	..*vs.* Trinidad R.C.	..Away	Won 5-3.
10th Nov.,	..*vs.* do.	..Away	Won 11-0.
24th do.	..*vs.* Southern R.C.	..Away	Won 32-0.
3rd Dec.,	..*vs.* H.M.S. *Wistaria*	Home	Won 22-0.
6th do.	..*vs.* Trinidad R.C.	..Away	Won 3-0.
11th do.	..*vs.* Southern R.C.	..Away	Won 13-0.
20th do.	..*vs.* Trinidad R.C.	..Home	Lost 3-5.
9th Feb.,	..*vs.* do.	..Home	Won 20-5.

Points for : 109. | Against : 13.
Won : 7 | *Lost :* 1.

Association Football Club, 1927-28.

The College Association Football XI have played ten matches in all this season. Of these matches four have been won, three drawn and three lost. The College scored an aggregate of twenty-four goals while a total of nineteen goals was scored against them. The College registered victories over the Harlequins, the Queen's Royal College, the Caroni Sugar Estate and H.M.S. *Heliotrope*. They drew twice against the Trinidad Constabulary and once with Casuals who beat them in a return match. They also lost to the Sporting Club and the Trinidad Leaseholds, Ltd. The following have represented the College during the season.

Goal :
G. N. K. Turnbull.

Backs :
C. B. Taylor, J. L. Greig.

Half-Backs :
J. A. MacDonald, A. K. Briant, A. W. Sheffield.

Forwards :
E. S. Chin, J. D. Broatch, J. E. Bruce, R. R. Follet-Smith, G. MacG. Bain.

Hockey Club, 1927-28.

The results of the matches played by the College Hockey Club will be announced as soon as the League contests are over.

COLLEGE NEWS.

Professor H. A. Ballou sailed for St. Lucia on 24th February in his official capacity as Commissioner of Agriculture.

* * *

Mr. C. T. Watts, Engineer and Technical Assistant to the College, returned to Trinidad by the s.s. *Carare* accompanied by his wife and child on 28th January.

* * *

A resolution has been passed by the Legislative Council of Barbados, granting the sum of £50 to Dr. E. A. Seagar for his services to the colony in connection with the outbreak of malarial fever.

* * *

Mr. J. L. Illingworth, an ex-student of the Imperial College of Tropical Agriculture, has been appointed Curator of the Virgin Islands and will proceed to Tortola to take up his new post this month.

* * *

At a meeting of the Trinidad Science Club on 23rd February, Mr. F. Urich, F.E.S., C.M.Z.S., Assistant Professor of Zoology and Entomology, gave a lecture on "The Cocoa Industry of San Thomé."

* * *

Our note in the February issue on Sir Thomas Holland should have read, "The College has recently been visited by Sir Thomas Holland, K.C.S.I., F.R.S., the distinguished geologist and Rector of the Imperial College of Science and Technology."

* * *

Mr. Geo. Moody Stuart, the Chairman of the Finance Committee of the Imperial College of Tropical Agriculture, spent several days early in March at the College as the guest of the Principal and Mrs. Evans. He was accompanied by Miss Moody Stuart.

* * *

The thanks of the Governing Body have been conveyed to Messrs. J. and E. Hall, the well known Refrigerating Machinery and Engineering Firm, for their generosity in contributing £100 towards the cost of a Provision Store to be attached to the new cold storage plant that is about to be erected at the College in Trinidad.

* * *

Our heartiest congratulations are offered to Mr. R. E. Hunter, Lecturer in Botany and Genetics, who was married in Barbados on 9th February to Miss Mottram. Mr. and Mrs. Hunter are at present the guests of the Principal and Mrs. Evans and will shortly move into a house which is being prepared for their use near the College.

* * *

The College has received from Mr. J. W. Stephens of Port-of-Spain the gift of a Himmler biological microscope, with revolving and semi-travelling stage, and focussing substage condenser, complete with three objectives, including a 1·4 mm. oil immersion lens. For this useful addition to our equipment we heartily thank the donor, by whose generosity the College has benefited on more than one previous occasion.

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Recent visitors to the College include Mr. and Mrs. C. W. Doorly, Mr. J. Gordon Miller and Mr. and Mrs. William A. Cadbury and Miss Cadbury. Mr. Doorly is the recently appointed Administrator of St. Lucia, Mr. Gordon Miller is the Chairman of Directors of the Caroni Sugar Estates, Ltd., and Mr. Cadbury is one of the Directors of the well known firm of chocolate and cocoa manufacturers. His son, Mr. J. Cadbury and Mr. Brady, who is one of the Heads of Departments at the Bournville works, stayed a few days at the College and discussed the general cocoa production situation with members of the staff.

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The Hon. Sir Francis Watts, K.C.M.G., D.SC., returned to Trinidad by the s.s. *Carare* on 28th January after seven months absence. He left Trinidad on 28th June and after spending some time in England arrived at Capetown on 3rd October, where he attended, as a representative of the West Indian Chamber of Commerce and of the College, the Congress of the Federated Chambers of Commerce which sat for four days. Leaving Capetown on 10th October the members of the Congress proceeded on an extensive tour, visiting the chief places of interest at Worcester, Kimberley, Mafeking, Bulawayo, the Victoria Falls, Salisbury, Johannesburg, Pretoria, Ladysmith, Colenso, Pietermaritzburg, Durban, Bloemfontein, and Port Elizabeth which was reached on 1st November. Here Sir Francis left the delegates and from Durban caught a ship to Mauritius where he spent eleven days. He then returned to England *via* Capetown. Sir Francis was nominated a member of the Trinidad Legislative Council on 9th February and is to be heartily congratulated on his new appointment.

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A visit to Palmiste Estate organised by the College Department of Agriculture, took place on Wednesday, 9th February. The party of thirty-one students was accompanied by the Principal, Professor Wood, Professor Briton-Jones, Professor Cheesman, Professor Shephard, Mr. A. L. Baker and Messrs. Kelsick and Gomez. Sir Norman Lamont, proprietor of Palmiste, a Governor of the College, and the Manager, Mr. J. C. Augustus, demonstrated the method of planting and shading young cacao under "Balisea" and the care of a cacao estate in full bearing. The Manager gave a short address on pruning with a practical demonstration and exhibited a collection of tools used in cacao cultivation and harvesting. The party was shown areas under different species of coffee and the cultural pruning methods, &c. The method of preparing for market was demonstrated. After lunch Sir Norman gave an interesting account of the history of the estate which has been in the hands

of his family since 1819. The attempt to cope with changes in the production of sugar, by increasing centralisation, having not proved profitable the estate has been given over to cane farming and estate cacao, coconut and coffee cultivation. One of the interesting things about the estate was that cacao had been grown successfully on land which at one time had been considered most unsuitable. After lunch a visit was paid to the coconut plantation. Mr. G. C. Skinner and the Hon. W. G. Freeman, Governors of the College, joined the party during the visit. Thanks are due to Sir Norman Lamont, Mr. Augustus and the ladies who co-operated to make the visit so profitable and enjoyable.

COLLEGE DINING HALL.

On page xi will be found a photograph of the College new Dining Hall. The Hall, which is two-storied high, was designed by Mr. C. T. Watts, Engineer and Technical Assistant to the College, and was built by the College workmen at a cost of £4,350 out of funds provided for the purpose by the Empire Marketing Board.

The ground floor consists of a large fly-screened dining hall capable of accommodating one hundred students, with a kitchen, a store room, manager's office, students' and servants' cloak rooms. A spacious gallery with reading, billiard and bridge rooms and a bar compose the upper floor. A most welcome gift from the Governors of the College in the shape of a very fine full size mahogany billiard table by "G. Wright & Co.", with twelve ash cues, three balls and all other accessories has recently been fitted up in the billiard room. Other welcome gifts include a gramaphone presented by Mr. J. W. Stephens, a collection of books forwarded by the Secretary of the College and the following newspapers and journals which are supplied free regularly: the *Times* daily and weekly edition, the *Times Trade and Engineering Supplement*, the *Times Literary Supplement*, the *Daily Telegraph*, the *Trinidad Guardian*, the *Navy, United Empire*, the *Overseas Journal*, the *West India Committee Circular*, the *Field*, *Truth*, the *Isis* and papers published by the *British Cotton Growing Association*. The clock which can be seen on the photograph was presented by the West Indian Atlantic Group Committee and stood over the West India Pavilion at Wembley. The Hall is entirely built of reinforced concrete and was ready for occupation at the end of September but finally completed at the end of November.

CEYLON AND MALAYA RUBBER.

Current Quarter's Export Restriction.

The Colonial Office announces that the percentage of standard production of rubber which may be exported at the minimum rate of duty from Ceylon and Malaya for the quarter beginning 1st February will be sixty.

SIR THOMAS HOLLAND'S ADDRESS.

Members of the College had the great privilege on 17th February of hearing Sir Thomas Holland speak on "The Imperial Scientific Services." In his introduction of the speaker the Principal outlined Sir Thomas' career and stated that the College had indeed been fortunate in having one of the most eminent Empire administrators to address them that day.

Proceeding with the subject of his address, which he treated from the broadest possible aspect Sir Thomas spent much time explaining what was meant by the Imperial Idea. The growth of Imperialism was, he said, mainly dependent on religious, linguistic and political unity and that without this unity it would be difficult to build an Empire. He then sketched the history of the Roman Empire and described it as one that had tried to civilize the world by breaking tribal bonds and drawing scattered civilizations under a system of universal jurisprudence and universal belief in the one head—the Imperator Pacifix. When Europe, after the Renaissance, began to overcome the world, England soon became the leader in the discovery and appropriation of new countries. England, however, as the conqueror, proceeded somewhat differently from Rome as it gave complete political, religious, and industrial liberty to those countries which it conquered so that they eventually became self-governing dominions, crown colonies or protectorates. England's policy had all along been to regulate international affairs and to protect the weaker nations. A policy of war could never be pursued in an Empire where so many of the countries which built it up were scattered and where, as a result, it would be difficult to prepare for such an eventuality. At the same time in all vital questions of Imperial Policy the parts which made the whole were always consulted before final action was taken. England was now the Imperator Pacifix, but the nucleus that held the cell or the Empire together was the Crown.

Sir Thomas concluded his address by telling the students that, as future colonial servants they should make the most of what raw materials they had at their disposal and wherever possible, develop industries on the spot and turn out the finished product instead of relying on European scientists to do it for them. The movement of the decentralization of industrial areas had already begun and he felt sure it would continue. He warned them against the danger of pure science and gave as a parallel, classics, which he said had at one time become a study of rhetoric and grammar instead of a study of humanities. The greatest science of all was the science of the earth, but it was on agriculture that all the sciences were eventually confined. His final message was that, as some of the first colonial students they were pioneers of a movement of which he expected much greater things.

Sir Francis Watts proposed the vote of thanks which was heartily cheered by all those present.

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR :—At the beginning of February the sugar market was dull, values in the United Kingdom moving in sympathy with the downward trend in America. Daily cabled prices on the London market have shown the following trend : Foreign 96° *c.i.f.* per cwt. 12*s.* (1st Feb.) ; 11*s.* 9*d.* (17th Feb.) ; 12*s.* 3*d.* (29th Feb.) ; and 12*s.* 3*d.* (12th Mar.). Preferential, *c.i.f.* per cwt. 15*s.* (1st Feb.) ; 15*s.* 6*d.* (17th Feb.) ; 15s. 10½*d.* (29th Feb.) ; 16*s.* 0*d.* (12th Mar.). The public is not buying sugar to the extent that the increase in sweetstuffs and in the confectionery business would indicate. At the beginning of February the first important step was taken towards the marketing of the 600,000 tons of present crop Cubas outside the United States ; 332,000 tons were purchased by European interests.

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COTTON :—The mid-February market showed a decided resistance to further decline. The recovery could only be ascribed to a natural reaction, but if it is sustained long enough, trade support will be forthcoming and prices will tone under its influence. On 9th February, mid-American was quoted at 10·10*d.* The Liverpool Circular (10th Feb.) quoted Sea Island (good) at 24*d.* per lb. with moderate business, Egyptian Sakel (good) 18·50*d.* per lb. with moderate business. The African market was quiet, and moderate business passed in East Indian.

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COCOA :—The market continues very dull, but there is a steady undertone due to continued firm holding of Accra grades. Manufacturers appear to be buying sparingly. New York values for various grades are :

	Shipment. cents.	*Spot.* cents.
African :		
F.F. Accra	13¾	13¾
F.A.Q. Lagos	13½	13½
Cameroon	—	—
Bahia :		
Supt.	13⅝-14	14⅛-14¼
G.F.	13¾	14
F.F.	13⅝	13¾
Guayaquil :		
Summer	17	17½-18
Seasons	—	15¼
Machala	—	14⅞
Caraquez	—	14¾-14⅞
Trinidad :		
Estates	14⅝	14¾
Ordinary	14⅜	14¼
Caracas	15⅛	15¼
Venezuelan :		
La Guayra	14⅝	14¾
Carupano	—	14½
Pto. Cabello	—	22-22½
Maracaibo	—	22-23
Sanchez	13¼	13⅛-13¼
Haiti	12¾	12¾
Ceylon	23	—
Java	—	24½
Grenada :		
Estates	14¼	14¼
Jamaica	—	13¼
Costa Rica	14	—
Panama	14	—
Surinam :		
Estates	—	14¼
Ordinary	—	14
Samoa	—	—

London market is interested in small lots of spot Trinidad and Grenada Cocoa at premiums.

The above information was very kindly given by the Secretary of the Cocoa Planters' Association, Trinidad.

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COFFEE :—Sales have included, Tanganyika at 147*s.* to 149*s.* per cwt., Vera Paz new crop at 136*s.*, Colombian at 151*s.*, Kilimanjaro at 140*s.* and Uganda at 110*s.* to 115*s.*

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TEA :—Java tea rallied in February and at lower prices there were larger sales of Indian. Ceylon improved. Averages for the first week of February were Indian, 17·94*d.* ; Java, 13·96*d.* ; Sumatra, 19·61*d.* ; Nyasaland, 11·75*d.* ; Assam, 17·22*d.* ; and Darjeeling 19·07*d.* per lb.

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RUBBER :—On the 9th February consternation was caused by the announcement that the Prime Minister had ordered an enquiry by the Committee of Civil Research in regard to the question of Restriction, whether it should be removed, modified or continued. The news only caused a slight reaction in New York, but the market in London opened more or less in a panic, and a few minutes after opening prices showed a fall of over 2*d.* per lb. since the close of the day before. By 15th February prices were 3½*d.* to 4*d.* per lb. lower than before the announcement. The trend of prices for plantation sheet has been per lb. 1*s.* 6⅝*d.* (1st Feb.) ; 1*s.* 5⅞*d.* (8th Feb.) ; 1*s.* 4⅜*d.* (9th Feb.) ; 1*s.* 1½*d.* (22nd Feb.) and 11⅞*d.* (12th Mar.).

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COPRA :—The market is not good but the pause in inquiry does not seem to have affected prices materially. The quotation for West Indian *c.i.f.* per ton was £27 17*s.* 6*d.* on 12th March.